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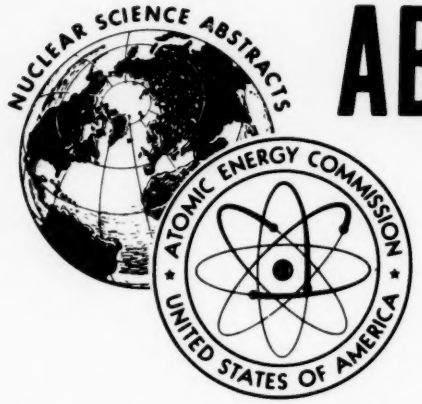

Volume 26 Number 11

Abstracts 25132-27727

June 15, 1972

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Volume 26, Number 11, June 15, 1972

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Personal Authors

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    alloys V3Si--Nb3Al,  25:1093 (CALT-822-13)
NEWLAND, E. A., Radiation treatment of sewage,  25:140
    (AAEC/LIB/81b-254)
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TRANSURANIUM ELEMENTS
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    25:40 (IDO-12073, pp 28-36)
  separation by ion exchange and complex-formation elution,
    25:251(P)
TRIETHYLENETETRAMINE
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    radiation effects on labeled, thermal-neutron,  25:137
TRITIUM
  content in Cattaraugus Creek near West Valley Processing
    Plant, July through Dec. 1969,  25:258 (DOCKET-50201-
    48)
  content in Cattaraugus Creek near West Valley Processing
    Plant, Jan. to July 1970,  25:259 (DOCKET-50201-49)
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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 25245, 25999, and 26000.

Activation and Nuclear Reaction Procedures

Refer also to abstracts 26955 and 27057.

25132 (AD-733450) DETERMINATION OF PICOGRAM AMOUNTS OF ^{99}Tc BY NEUTRON ACTIVATION ANALYSIS. Final Report. Foti, S.; Delucchi, E.; Akamian, V. (Naval Ordnance Lab., White Oak, Md.). 23 Sep 1971. 17p. (NOLTR-71-119). NTIS.

Thermal neutron activation of ^{99}Tc to ^{100}Tc by the (n,γ) reaction was used to determine picogram amounts of ^{99}Tc in a highly purified aqueous medium. A rapid post-irradiation procedure was developed to purify and separate the ^{100}Tc fraction from other induced radionuclides in 40 to 45 seconds. The technetium yield of 53 ±5% was conducted in a low-background beta counter. (auth) (NTIS)

25133 ACTIVATION ANALYSIS BY CHERENKOV COUNTING OF THE 22 MS ^{12}B. Grass, F. (Oesterreichische Hochschule, Vienna). Atomkernenergie; 10: No. 2, 117-18(Apr 1972). (In German).

The determination of boron in aqueous and solid samples using a rapid transport automatic is described. The 22-ms ^{12}B is detected by a Cherenkov counter. It is shown that ^{12}B is very effectively discriminated from 20-ms ^{24m}Na. (auth)

25134 MULTIELEMENT NEUTRON ACTIVATION ANALYSIS OF BIOLOGICAL MATERIAL USING CHEMICAL GROUP SEPARATIONS AND HIGH RESOLUTION GAMMA-SPECTROMETRY. Morrison, G. H.; Potter, N. M. (Cornell Univ., Ithaca, N. Y.). Anal. Chem.; 44: No. 4, 839-42(Apr 1972).

Chemical group separations and high-resolution γ spectrometry were combined with instrumental neutron activation methods for analysis of biological specimens to obtain maximum elemental information with a minimum of chemical separations. Information could be obtained on 31 elements with the neutron flux available. Problems associated with determination of As, Ca, Cd, ^{115m}In, Cs, Rb, Cu, Mg, Mn, Mo, Sb, Sc, and Se are discussed. (M.C.G.)

25135 ACTIVATION ANALYSIS OF HUMAN HEAD HAIR. 5. ANALYSIS OF HUMAN HEAD HAIR IN A SIMULATED CASE BY NEUTRON ACTIVATION. Kozuka, Hiroshi (National Research Inst. of Police Science, Tokyo). Eisei Kagaku; 17: No. 5, 327-9(Oct 1971). (In Japanese).

Six single hairs of the head from five individuals were sampled and analyzed by neutron activation. Two samples which originated in the same person could be correctly selected by their analysis. As a method for hair individualization, Na, Cl, Br, and Mn in the samples were determined, and examinations were made to see whether each element could be identified at matching limits of 10, 25, or 50%. It was concluded that 25% was usually permissible as the matching limit in practical cases. For a value of more than 50% as the limit, more elements such as Zn, Hg, and others must be determined and the results must be collectively considered. There were no remarkable differences between the concentration of trace elements in a single hair and in strands of hair from the same individual. (auth) (Japan)

25136 ACTIVATION ANALYSIS AID IN GEOPHYSICAL INVESTIGATIONS ON FLUORITE-BEARING STRATA. Bartosek, J.; Kasparec, I.; Skuthan, B. Z. Angew. Geol.; 17: No. 8, 333-7 (Aug 1971). (In German).

Mineral samples of approximately 2 g are exposed for 10 s to a beam of fast neutrons originating from a neutron generator. Following irradiation, the samples are automatically guided to a detector. After decay of short-lived nuclides, the remaining activity is measured in a 512-channel analyzer. The spectrum then indicates the content of fluorine (spectral line at 662 keV). With a relative error of approximately 30%, the contents can be determined directly. The sensitivity suffices for prospecting purposes. Simultaneous determination of SiO_2 (spectral line 1.78 MeV) seems possible. (H.B.G.)

25137 GAMMA-EMITTING SHORT-LIVED NUCLIDES FORMED BY NEUTRON ACTIVATION. Okada, Minoru (Japan Atomic Energy Research Inst., Tokai). Radioisotopes (Tokyo); 21: No. 1, 46-53(Jan 1972).

Original elements for interfering reactions in neutron activation analysis are shown. The types of reaction responsible for the activity and gamma energies and intensities are given. (M.C.G.)

25138 K-1-PLANT FOR DETERMINATION OF OXYGEN. Isotopenpraxis; 7: No. 11-12, 466-70(Nov-Dec 1971). (In German).

K-1 installations consist of a neutron generator with closed accelerator tube, a gamma scintillation spectrometer with one channel, and a computer unit. By means of two pneumatic tubes, standards and samples are transported between irradiation and counting areas. The generator produces 14-MeV neutrons through the T(D,n)^{4}He reaction. Characteristics of the installation are as follows: lower limit of measurable oxygen content in 80 g samples, 3×10^{-4}%; time requirement for an analysis less than 5 min; measuring error at oxygen contents from 0.01 to 0.1%, maximal 10%; neutron flux, 6×10^8 n/s; and weight of the installation, without shielding, approximately 600 kg. Discussed are practical applications for oxygen determinations in the production processes of titanium, beryllium, steel, and copper. Measurements of fluorine and boron are mentioned. (H.B.G.)

25139 USE OF NON-DESTRUCTIVE ACTIVATION ANALYSIS AND PATTERN RECOGNITION IN THE STUDY OF FLINT ARTEFACTS. de Bruin, M. (Interuniversity Reactor Inst., Delft, Netherlands); Korthoven, P. J. M.; Bakels, C. C.; Groen, F. C. A. Archaeometry; 14: No. 1, 55-63(Feb 1972).

A method is described for the identification of the origin of flint artefacts. The method is based on the variation in the trace element concentrations for different origins. The trace element concentrations were determined by nondestructive neutron activation analysis. The identification was obtained from a pattern recognition analysis. (auth)

25140 NEUTRON ACTIVATION ANALYSIS OF PREHISTORIC FLINT MINE PRODUCTS. Aspinall, A. (Univ. of Bradford, Eng.); Feather, S. W. Archaeometry; 14: No. 1, 41-53(Feb 1972).

Specimens of flint from English and Continental prehistoric factory or mine sites were analyzed using neutron activation and element compositions compared. The possible use of element concentration patterns as a means of characterizing such sites is discussed. (auth)

25141 NEUTRON ACTIVATION ANALYSIS OF FAIENCE BEADS. Aspinall, A. (Univ. of Bradford, Eng.); Warren, S. E.; Crummett, J. G.; Newton, R. G. Archaeometry; 14: No. 1, 27-40(Feb 1972).

A selection of faience beads was examined using neutron activation analysis, with a view to distinguishing the provenance of individual specimens. Evidence is presented that the tin content in beads from British sites is significantly higher than in those from other areas. Characteristic features of beads from other sources are also discussed. (auth)

25142 PRINCIPLES AND APPLICATIONS OF SUBSTOICHIOMETRIC TECHNIQUES OF ANALYSIS. Baishya, N. K. (Univ. of Gauhati, Assam, India); Heslop, R. B. CRC Crit. Rev. Anal. Chem.; 2: No. 3, 345-82(Nov 1971).

The application of the substoichiometric principle to radiochemical separations in activation and isotope dilution analyses is reviewed. The review includes principles and methods of substoichiometric separation; preliminary experiments in substoichiometric techniques of analysis; application of substoichiometric method in radioanalysis; instrumentation; some alternative radioanalytical methods; and possible developments. (D.H.M.)

25143 ANALYSIS OF GOLD COINS: A COMPARISON OF RESULTS OBTAINED BY NON-DESTRUCTIVE METHODS. Oddy, W. A. (British Museum Research Lab., London). Archaeometry; 14: No. 1, 109-17(Feb 1972).

A systematic difference between the results found when a series of Dark-Age gold coins was analysed both by neutron activation and by specific gravity analysis and when a second series of similar coins was analysed by the Oxford Milliprobe and by specific gravity is discussed. No reason is given for this systematic difference, although there is evidence that all these methods are slightly in error, two of them giving results for gold which are too high and the specific gravity method giving results which are too low. (auth)

25144 COMPARISON OF METHODS OF ANALYSIS OF SILVER AND GOLD IN SILVER COINS. Schweizer, F. (Oxford Univ.); Friedman, A. M. Archaeometry; 14: No. 1, 103-7(Feb 1972).

A series of silver coins was analysed for silver and gold contents by three methods, chemical wet analysis, activation analysis, and x ray fluorescence using a point source linear spectrometer (milliprobe). The results indicate that while the x ray fluorescence technique gives better agreement with chemical analysis for major components, the use of activation analysis with automated equipment results in a considerable saving of time and has a high sensitivity for some minor components. (auth)

25145 NEUTRON-ACTIVATION ANALYSIS FOR THORIUM IN ZIRCON. Desai, H. B.; Parthasarathy, R.; Das, M. Sankar (Bhabha Atomic Research Centre, Bombay). Talanta; 19: No. 3, 363-6(Mar 1972).

The thorium content of zircons and standard rock samples was determined by neutron activation analysis. The 310-keV photopeak activity of ^{233}Pa was enhanced by a prior chemical separation which removed interfering induced activities. (auth)

25146 ACTIVATION ANALYSIS DETERMINATION OF URANIUM TRACES IN MARINE SYSTEMS WITH SEPARATION OF ^{239}Np BY COUNTERCURRENT ION EXCHANGE. Bilal, B. A.; Braetter, P.; Muehlig, B.; Roesick, U.; Zimen, K. E. (Hahn-Meitner-Institut, Berlin). Radiochim. Acta; 16: No. 3-4, 191-2(Dec 1971). (In German).

Seawater samples containing about 20 ppM uranium as uranyl nitrate were exposed to a thermal neutron flux density of 5.1×10^{n} cm^{-2} s^{-1} and the radionuclides produced were identified by γ spectrometry. The neptunium fraction can be separated by ion exchange and determined by γ spectrometry to improve the sensitivity of the uranium determination. (M.C.G.)

25147 RAPID METHOD FOR ASSAYING SULFUR USING PROTON ACTIVATION ANALYSIS. Thomas, J.-P.; Schweikert, E. A. (Texas A and M Univ., College Station). Nucl. Instrum. Methods; 99: No. 3, 461-7(1972).

A novel application of charged-particle activation analysis is presented involving short irradiations of 1 s coupled with the measurement of very short-lived nuclides. The case studied deals with the determination of sulfur using $^{32}S(p,n)^{32}Cl$. This activation reaction features a high-abundance target isotope and a product nuclide of very short half-life (300 ms) emitting high-energy positrons. Counting was performed with a Cherenkov detector at the irradiation site immediately after bombardment. The experimental approach for optimizing the counting conditions is described, and the activation curve for $^{32}S(p,n)^{32}Cl$ is given for proton energies up to 22.5 MeV. The sensitivity based on experimental data is estimated at ≈ 50 $\mu g/cm^2$. The application of this technique to petroleum products with sulfur contents ranging from 3.18 to 0.72% is discussed. (7 figures, 5 tables) (auth)

25148 ELEMENTAL ABUNDANCES IN METEORITIC CHONDRULES. Osborn III, Thomas Ward. Corvallis, Oreg.; Oregon State Univ (1972). 368p. University Microfilms Order No. 72-9820.

Thesis.

High-precision instrumental neutron activation analysis was used to determine Al, Na, Mn, Sc, Cr, Fe, Co, and Ni in a suite of more than 500 chondrules from 26 distinct meteorites. These meteorite specimens represent the H, L, LL, and C chemical classes and most of the petrologic types. In addition radiochemical activation analysis was used to determine K, Rb, and Cs in a suite of chondrules from the LL chemical class. To a limited extent trace element data on individual chondrules were correlated with petrographic observations on the same chondrules. In general it was found that the siderophilic elements Fe, Co, Ni, and Ir are depleted in chondrules compared to the whole chondrite. The lithophilic elements Na, Mn, Sc, Cr, and Al are generally enriched in chondrules compared to the whole chondrite. In contrast to the other lithophilic elements, Rb and Cs are generally depleted in the chondrules. Both major and trace elements may exhibit multimodal population distributions for the chondrules sets. Petrographic observations of the same chondrules for which trace element contents were determined by INAA suggest that the trace element distribution may be consistent with the mineral assemblages except for positive Ir–Al and Al–Sc correlations that occur in many chondrule sets. Correlations between chondrule mass and Al, Na, Sc, Co, Ir, and Cu contents were observed for certain chondrule sets. Chondrules from the H and LL groups appear to exhibit consistent compositional variations in going from low petrographic grades to high petrographic grades. The variations are observed most readily for increasing Al–Na correlation coefficients and decreasing Mn–Na correlation coefficients with increasing petrologic types. A decrease in the dispersion of Mn and Na was also observed with increasing petrologic types. Na contents in the chondrules increase as a function of petrologic type. These observations are interpreted as indications of increasing equilibration of the chondrules with their matrices. The Ni/Co ratio was found to be variable within chondrules from the same meteorite; for example, the range in Ochansk chondrules is from 10 to 60. Theories concerning the origin of chondrules are discussed in the context of the elemental abundances and correlations observed in this study. (Diss. Abstr. Int., B)

25149 RECENT DEVELOPMENTS IN ACTIVATION ANALYSIS. Pierce, T. B. (Atomic Energy Research Establishment, Harwell, Eng.). Selec. Annu. Rev. Anal. Sci.; 1: 133-75(1971).

The subject is considered under the following headings: general considerations (techniques of activation analysis), methods of isolation of activity (chemical separation techniques, radiation measurement), neutron activation analysis (reactor activation analysis—delayed and prompt techniques, accelerator neutron sources—delayed and prompt techniques, radioisotope neutron sources), charged particle activation analysis (delayed techniques, prompt techniques—elastic scattering, prompt γ radiation, particle group measurement and nuclear positive ion microprobe), and γ photon activation analysis. (300 references) (UK)

25150 MERCURY CONCENTRATIONS IN MUSEUM SPECIMENS OF TUNA AND SWORDFISH. Miller, G. E.; Grant, P. M.; Kishore, R.; (and others) (Univ. of California, Irvine). Science; 175: No. 4026, 1121-2(10 Mar 1972).

The mercury levels of museum specimens of seven tuna caught 62 to 93 years ago and a swordfish caught 25 years ago were determined by instrumental neutron activation analysis. These levels are in the same range as those found in specimens caught recently. (auth)

25151 CHARACTERIZATION OF ANCIENT BRONZE ARTIFACTS BY NEUTRON AND PHOTON ACTIVATION ANALYSIS. Thompson, B. A.; Lutz, G. J. (National Bureau of Standards, Washington, D. C.). Radiochem. Radioanal. Lett.; 9: No. 5-6, 343-50(31 Mar 1972).

Concentrations of nine major and minor constituents were determined in samples of two ancient bronze artifacts using neutron and photon activation analysis. The analysis was carried out without chemical separation on 10 mg samples of the material. The results demonstrate the unique capability of nuclear methods for analysis of small portions of artifacts in archeology. (auth)

25152 DETERMINATION OF MOLYBDENUM IN BLOOD AND BIOLOGICAL MATERIALS BY NEUTRON ACTIVATION ANALYSIS. Morgan, A.; Holmes, A. (Atomic Energy Research Establishment, Harwell, Eng.). Radiochem. Radioanal. Lett.; 9: No. 5-6, 329-34(31 Mar 1972).

A procedure for determination of molybdenum in blood and other biological materials by activation analysis is described. It involves the chemical separation of molybdenum, utilizing both anion exchange and solvent extraction with HDEHP, after which

^{90}Mo is β counted as the α-benzoin oximate. The sensitivity of the procedure is about 2×10^{-10} g. The results obtained indicate that the normal level of molybdenum in whole blood from normal subjects in the U.K. is about 1 ng/ml. (auth)

25153 DETERMINATION OF PHOSPHORUS IN POLLEN AND SPOROPOLLENINS USING NEUTRON ACTIVATION TECHNIQUES. Fawcett, P.; Green, D.; Shaw, G. (Univ. of Bradford, Eng.). Radiochem. Radioanal. Lett.; 9: No. 5-6, 321-7(31 Mar 1972).

The phosphorus content of pollen and derived sporopollenins was determined by neutron activation analysis. (auth)

25154 REMOVAL OF SODIUM FROM MINERAL ACID SOLUTIONS BY ADSORPTION ON MODIFIED POLYANTIMONIC(V) ACID ION-EXCHANGER. Caletka, R.; Konecny, C.; Simkova, M. (Inst. of Nuclear Research, Rez, Czech.). J. Radioanal. Chem.; 10: No. 1, 5-15(Feb 1972).

Removal of sodium from mineral acid solutions by adsorption on polyantimonic(V) acid supported on silica gel is described. This material has favorable cation-exchange properties including a high mechanical stability and a suitable rate for adsorption in column operation. The suitability of the ion-exchanger for analytical purposes, such as activation analysis of biological samples, was ascertained. (auth)

25155 NEUTRON ACTIVATION ANALYSIS FOR PLATINUM IN Cr_2O_3. Butler, J. W.; Becknell, D. E. (Ford Motor Co., Dearborn, Mich.). J. Radioanal. Chem.; 10: No. 1, 47-50 (Feb 1972).

A method for the analysis of platinum in Cr_2O_3 was developed for amounts of Pt ranging up to 2.5 mg. The method employs the separation of activated Pt into ethyl acetate after its reduction by $SnCl_2$. The areas under the 192-keV γ ray from the decay of ^{197}Pt in standards and samples are used to calculate the amount of Pt in the samples by the standard comparison technique. It was shown that up to 2.5 mg of Pt can be recovered by the solvent extraction procedure. The precision of the analysis has varied up to 5%. (auth)

25156 PURITY CONTROL OF LEAD METAL. Bishay, T. Z. (Scottish Research Reactor Centre, Glasgow). J. Radioanal. Chem.; 10: No. 1, 51-64(Feb 1972).

Several simple radiochemical procedures for determination of calcium, copper, antimony, and mercury in different lead samples are described; ppM concentrations (or even less) can be assayed with good reproducibility. (auth)

25157 SIMULTANEOUS DETERMINATION OF RUBIDIUM, CESIUM, CHROMIUM, AND PHOSPHORUS IN ROCKS BY NEUTRON ACTIVATION AND A SIMPLE GROUP SEPARATION. Steinnes, E. (Institut for Atomenergi, Kjeller, Norway). J. Radioanal. Chem.; 10: No. 1, 65-73(Feb 1972).

A neutron activation method was devised for simultaneous determination of Rb, Cs, Cr, and P in silicate rocks. After alkaline fusion and removal of the insoluble hydroxides, the filtrate is assayed for Rb, Cs, and Cr by Ge(Li) γ spectrometry and for P by β counting. An additional hydroxide scavenging step permits the γ spectrometric measurements to be performed by means of a sodium iodide detector. Results obtained on some standard rocks are in good agreement with previous neutron activation data obtained by methods based on more complicated radiochemical procedures. (auth)

25158 REMARKS ON THE ANALYSIS OF THE PHOTOPEAKS OF SCINTILLATION GAMMA-RAY SPECTRA. Stoyanov, Ch.; Aleksandrov, L.; Gadjokov, V. (Inst. of Physics, Sofia). J. Radioanal. Chem.; 10: No. 1, 75-81(Feb 1972).

Physical considerations permit the asymmetry of the photopeak in scintillation γ spectra to be represented by a second Gaussian peak of lower intensity, accompanying the principal peak. The problem of finding the peak parameters is described as one reduced to solving an over-determined system of nonlinear equations, when the numbers of counts in the channels of the analyzer are given. The nature of ill-conditioned linear steps is discussed for the case of solving the problem by Newton's method. A solution procedure based on the regulation of the iteration process is proposed, and the concept of "α-approximative solution" of the given problem is introduced. The calculation procedure is illustrated on actual numerical examples by tables and diagrams, and the possibilities of checking the physical hypothesis and of additional control of the experimental conditions are described. (auth)

25159 SPATIAL NEUTRON FLUX DISTRIBUTIONS AROUND A 14-MeV NEUTRON GENERATOR. Van Grieken, R.; Speecke, A.; Hoste, J. (Univ., Ghent). J. Radioanal. Chem.; 10: No. 1, 95-104 (Feb 1972).

The neutron flux distribution in the vicinity of 30-, 20-, and 10-mm-diameter targets was measured by irradiating concentric ring-type iron monitors at different distances from the target and counting the induced ^{56}Mn activity. Considering the many uncertainties, satisfactory agreement was found between theory and experiment. (auth)

25160 APPLICATION OF CHROMATOGRAPHY ON COLUMNS OF NATURAL CELLULOSE IMPREGNATED WITH TRI-N-OCTYLPHOSPHINE OXIDE IN THE SEPARATION OF VARIOUS CATIONS. Blouri, J.; Revel, G. (CNRS, Vitry-sur-Seine, France). J. Radioanal. Chem.; 10: No. 1, 121-4(Feb 1972). (In French).

Experimental results of an investigation on cellulose treated with trioctylphosphine oxide for the column chromatography method used during the activation analysis of metals are presented. The most interesting results are obtained in the separation of Au–Sb–Tl. (auth)

25161 LOW-ENERGY GAMMA RAYS FROM ISOTOPES PRODUCED BY (n,γ) REACTIONS. De Bruin, M.; Korthoven, P. J. M. (Interuniversity Reactor Inst., Delft, Netherlands). J. Radioanal. Chem.; 10: No. 1, 125-35(Feb 1972).

The possibility of using the low-energy region of the γ spectrum in activation analysis is considered. The low-energy photon spectra of isotopes and isotope mixtures produced from natural elements by (n,γ) reactions were measured. Data are presented in tables. (M.C.G.)

25162 INTERFERENCE IN NEUTRON ACTIVATION ANALYTICAL DETERMINATIONS BY URANIUM FISSION. Erdtmann, G. (Kernforschungsanlage, Juelich, Ger.). J. Radioanal. Chem.; 10: No. 1, 137-8(Feb 1972).

An equation is given for calculation of the activity of fission products and the interference powers of the most important ones are listed. (M.C.G.)

Chemical and Spectral Procedures

Refer also to abstracts 25249, 25398, and 25967.

25163 (ANL–7794) MAGRAM: A COMPUTER CODE FOR QUANTITATIVE ELECTRON-MICROPROBE ANALYSIS OF RADIOACTIVE MATERIALS. Natesh, R.; Butler, E. M.; O'Boyle, D. R. (Argonne National Lab., Ill.). Oct 1971. Contract W-31-109-eng-38. 55p. Dep. NTIS.

A FORTRAN-IV computer code, called MAGRAM, was developed to correct and plot x-ray data collected with a shielded electron-microprobe analyzer. The measured x-ray intensities of up to three elements are corrected for system dead-time effects, beam-current drift, x-ray background, atomic number, x-ray absorption, fluorescence effects, and gamma-induced secondary radiation. The program allows a maximum of 300 separate analyses to be corrected in a single run and has printer and CALCOMP plotting operations for 1 to 99 points. The application of the program to measurements of the radial redistribution of uranium and plutonium in irradiated mixed-oxide fuel is illustrated. (auth)

25164 (ITE–64–F) PROBLEMS OF CHEMICAL ANALYSIS OF PRECIOUS METALS. Pohl, H. (European Communities, Brussels (Belgium). Commission). 1971. 221p. (In French). (CONF-711132–4). Dep. NTIS (U. S. Sales Only).

From Symposium on nuclear analysis techniques in the production and industrial use of noble metals; Brussels, Belgium (16 Nov 1971).

25165 (KFK–1496) HOLLOW CATHODES AS EXCITATION SOURCES IN THE EMISSION SPECTROSCOPIC DETERMINATION OF IMPURITY TRACES IN NUCLEAR FUELS. Aya-Ramirez, Orlando (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Nov 1971. 91p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Karlsruhe (West Germany).

Use of a hollow cathode as the source of excitation in trace determination by emission spectroscopy in ceramic nuclear fuels was investigated and the properties of hollow cathode discharge are discussed. The necessary conductivity of UO_2 was achieved with a UO_2–copper mixture in a 70:30 ratio. A special technique of preparation produced a gastight sample, which acts as the bottom of the hollow cathode. Only some 10 mg of UO_2 is required for preparation of the sample. Since the discharge is distributed over the entire surface of the sample and, moreover, the material removed remains in the discharge space for a relatively long period of time, maximum efficiency is achieved. Because of the small quantity (0.5 g/3 min) consumed per exposure, the same sample can be studied repeatedly. The reproducibility of this method is better than it is with the methods

so far used in trace determination in nuclear fuels. The lines of detection are about twice as sharp as those achieved in a light arc or spark (HW > 30 mÅ). This sharp focus is retained at high concentrations. Bands are encountered in the range between 2600 and 3600 Å, which impairs the sensitivity of detection of the elements whose lines of detection are in that range of wavelengths. The limits of detection attained with this method are in the range of specifications for nuclear fuels. The methods seem particularly advantageous when applied to carbide fuels, because these materials have good conductivities. (auth)

25166 INDIRECT SPECTROPHOTOMETRIC DETERMINATION OF OXALATE USING URANIUM AND 4-(2-PYRIDYLAZO)-RESORCINOL. Neas, Robert E.; Guyon, John C. (Univ. of Missouri, Columbia). Anal. Chem.; 44: No. 4, 799-805(Apr 1972).

A method that exhibits operational simplicity is presented for indirect spectrophotometric determination of the oxalate ion. The diminishment in absorbance effected by oxalate on the red uranium(IV)-4-(2-pyridylazo)resorcinal (PAR) complex allows oxalate determination at the ppM level in the presence of many foreign ions. The diminishment in absorbance at 515 nm is linear with oxalate in the range 0 to 3 ppM in the final solution. (auth)

25167 SIMPLE ANALOG SYSTEM FOR SIMULTANEOUS KINETIC ANALYSIS. Worthington, James B.; Pardue, Harry L. (Purdue Univ., Lafayette, Ind.). Anal. Chem.; 44: No. 4, 767-72 (Apr 1972).

A system for automatic graphical presentation of simultaneous kinetic analysis data is presented. The system uses the graphical extrapolation method for the determination of the concentration of two component mixtures. A simple analog circuit coupled with an X–Y recorder provides a graphical plot containing linear regions related to component concentration. Extrapolations from these linear regions provide concentration directly. The system is illustrated for determination of rare earth mixtures using a ligand exchange reaction. Quantitative determinations of lanthanum and neodymium mixtures down to 2×10^{-5} M with accuracies of 0.3 to 16% are reported. (auth)

25168 THEORETICAL AND EXPERIMENTAL EVALUATION OF MULTIELEMENT ANALYSIS BY FUNDAMENTAL HARMONIC ALTERNATING CURRENT POLAROGRAPHY. Bond, A. M.; Canterford, J. H. (Univ. of Melbourne). Anal. Chem.; 44: No. 4, 732-6(Apr 1972).

A method is given for the quantitative calculation of concentration ratios allowable in fundamental harmonic alternating current polarography for direct simultaneous determination of two reversibly reduced species with similar summit potentials. The particular examples given are for two waves whose summit potentials differ by 100, 150, 200, and 300 mV and for a precision of 1%. Concentration ratios of 1:100 to 100:1 are considered as characteristic of those likely to be encountered in routine analysis. Such ratios are allowable generally when the separation in summit potential is 300 mV or greater. However, for separations less than this, the possibility of simultaneous determination depends on the number of electrons involved in the charge transfer of both species as is described. Excellent agreement between theory and experiment was found, and the calculation method is considered to provide a reliable means for quantitatively computing the usefulness of the ac polarographic method for the determination of a particular species in the presence of another for any given concentration ratio for the simultaneous determination of both species. (auth)

25169 ISOTOPIC ANALYSIS OF CHROMIUM IN LUNAR MATERIALS BY MASS SPECTROMETRY OF THE TRIFLUOROACETYLACETONATE. Frew, N. M.; Leary, J. J.; Isenhour, T. L. (Univ. of North Carolina, Chapel Hill). Anal. Chem.; 44: No. 4, 665-71(Apr 1972).

A microtechnique for analysis of chromium in small samples of geological materials was developed. Following acid dissolution of 1- to 2-mg samples of silicate rocks, chromium is converted to a volatile chelate by reaction with 1,1,1-trifluoro-2,4-pentanedione (Htfa) in a sealed tube and extracted into hexane for subsequent analysis by isotope dilution and electron impact mass spectrometry. The chromium contents of USGS silicate rock standards PCC-1 (peridotite) and DTS-1 (dunite) and two Apollo 12 lunar samples (12070) and (12002) were determined and are in good agreement with other reported values. In addition, the method allowed determination of chromium isotope distributions in Apollo 11 fines (10084) and in Apollo 12 fines (12070), and four crystalline rocks (12002, 12038, 12052, and 12063), with uncertainties of 1%. The lunar chromium distributions are in agreement with terrestrial values and no significant variations were observed among the crystalline rocks or the fine materials. (auth)

25170 UTILITY OF THE SEPARATED AIR/ACETYLENE FLAME IN ATOMIC FLUORESCENCE SPECTROMETRY. Browner, R. F. (Imperial Coll. of Science and Tech., London); Manning, D. C. Anal. Chem.; 44: No. 4, 843-5(Apr 1972).

A study was made to find out improvement separation of the air–C_2H_2 flame produced with a synchronous detecting system of the type incorporated in most spectrometers. Detection limits both with and without flame separation, are presented for 22 elements commonly determined by atomic absorption spectrometry in the air–acetylene flame using a modulated system. In general, the greater reduction of flame emission provided by separation, the greater improvement in the detection limit. (M.C.G.)

25171 MASS SPECTROMETRIC ISOTOPE RATIO MEASUREMENTS AND PEAK AREA INTEGRATION USING THE PEAK-SWITCHING FEATURE OF THE AEI MS-902. Frew, N. M.; Isenhour, T. L. (Univ. of North Carolina, Chapel Hill). Anal. Chem.; 44: No. 4, 659-64(Apr 1972).

Precise measurements of isotope ratios using the standard voltage peak-switching circuitry of the AEI MS-902 double focusing mass spectrometer is described. Minor modification of the instrument and use of a small digital computer and data acquisition interface allow accurate peak area comparisons with precisions in the range of 0.1 to 1%, depending on sample amount. Limitations on precision and accuracy due to instability of the electrostatic sector are discussed. Discrimination effects due to the voltage switching are observed, but can be corrected for by reference to an appropriate isotope standard. In addition to isotope ratio determinations, the system can be used for accurate trace metal determinations by integration of the ion current produced by evaporation of the volatile metal chelate from the direct insertion probe. (auth)

25172 REEVALUATION OF THE PREPARATION OF ORGANIC COMPOUNDS FOR THE MASS SPECTROMETRIC ANALYSIS FOR ^{18}O. Fong, Bettie J.; Smith, S. R.; Tanaka, John (Univ. of Connecticut, Storrs). Anal. Chem.; 44: No. 4, 655-9 (Apr 1972).

Pyrolysis conditions that might be used to produce carbon oxides for ^{18}O analysis by mass spectrometry were studied. Yields of carbon oxides from unlabeled compounds varied depending on the compound and conditions used. If mercuric chloride is the "sensitizer," an amount equal in weight to the substrate should be used. With stannic chloride, better yields of carbon dioxide are obtained. Pyrolysis conditions of 500°C for one hour are recommended. (auth)

25173 DETERMINATION BY ANODIC STRIPPING VOLTAMMETRY OF SOME TRACE ELEMENTS IN Te, Pb, AND PbTe. Fano, V.; Scalvini, M. (CNR, Parma, Italy). Microchem. J.; 17: No. 1, 1-3(Feb 1972).

A method for determination of Cu, Cd, and Zn in Te, Rb, and Pb was developed. To separate the matrix from impurities, Te and Pb were precipitated from a nitric acid solution in the form of $TeO_2 \cdot xH_2O$ and $RbSO_4$, respectively. Polarograms were made and peak heights are given. (auth)

25174 TITRIMETRIC MICRODETERMINATION OF YTTRIUM AND SCANDIUM: DISODIUM SALT OF RHODIZONIC ACID AS COMPLEXING AGENT. Saxena, O. C. (Univ. of Allahabad, India). Microchem. J.; 17: No. 1, 68-71(Feb 1972).

Yttrium and scandium were determined separately in micro amounts by forming and decomposing the complex, rare earth monosodium trirhodizonate, with ceric sulfate. The complexes between rare earths and the disodium salt or rhodizonic acid were formed in the ratio of 1:3 at pH 4.9. Maximum error for yttrium and scandium was 1.7 and 1.1%, respectively. 0.0002 N H_2SO_4 was sufficient to affect the complexes. Interference by metal ions was also observed. (auth)

25175 DETERMINATION OF IODIDES IN MINERAL WATERS BY THE METHOD OF INVERSIVE VOLTAMMETRY WITH A STATIONARY MERCURY ELECTRODE. Khelashvili, K. V. (Inst. for Treatment at Health Resorts and Physical Therapy, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 65: No. 3, 609-12(Mar 1972). (In Russian).

An investigation was made of the action of (a) Cl^-, Br^-, and I^- ions, (b) other anions contained in mineral waters, and (c) the pH and electrochemical parameters per current unit of electrically dissolved film in determining trace concentrations (5×10^{-4} to 5×10^{-6}M) of iodides in mineral waters with a high content of chloride ions by the method of inversive voltammetry with a stationary mercury electrode. The technique of this determination was elaborated. (auth)

25176 DETERMINATION OF OXYGEN IN Nb USING THE INERT GAS FUSION TECHNIQUE. Chevallier, J.; Eymery, J. P.; Sptiz, J. P. (CEA, Grenoble, France). Mem. Sci. Rev. Met.; 68: No. 10, 719-26(Oct 1971). (In French).

The determination of O in Nb was studied. The effect of temperature and the nature of the bath composition (Pt, Fe–Ni, Ni–Nb, and Fe–Nb) on the extraction yield was investigated. The reducing fusion was carried out in a He current using a graphite crucible. (France)

25177 APPLICATIONS OF HYDROFLUORIC ACID AND FLUORIDES IN ANALYTICAL CHEMISTRY. Headridge, J. B. (Univ. of Sheffield, Eng.). CRC Crit. Rev. Anal. Chem.; 2: No. 4, 461-90(Jan 1972).

A review on the application of hydrofluoric acid and fluoride ion in analytical chemistry is presented that includes the use of aqueous solutions containing hydrofluoric acid as solvents; the use of fluoride ion as a complexing agent in development of ion exchange, partition chromatography, and solvent extraction separation processes; use of fluoride as precipitant for certain cations with which it forms insoluble salts; the use of the profound effect of fluoride on the formal potentials of certain redox couples in the development of methods for the determination of many elements by titration and polarography; and miscellaneous applications of fluoride ions including its use as masking agent and as a reagent to improve the sensitivity with which elements such as Zr and Ta can be determined by atomic absorption spectroscopy. Stability constants of fluoride complexes are given for various ions including Th^{4+}, Pa^{5+}, U^{4+}, UO_2^{2+}, and Pu^{4+}. (D.H.M.)

25178 DETERMINATION OF LOW CONTENTS OF NIOBIUM IN HIGHLY ALLOYED NICKEL-BASE ALLOYS (EXCHANGE OF EXPERIENCE). Mal'tsev, V. F.; Volkova, N. P.; Pashchenko, E. N.; Novak, V. P. (All-Union Scientific-Research Inst. and Design-Engineering Inst. of the Pipe Industry, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 37: No. 9, 1329-30(Sep 1971).

Translated from Zavod. Lab.; 37: No. 9, 1048-9(Sep 1971).

A procedure was developed for the determination of small amounts of niobium in an alloy of 60% Ni, 6% W, 21% Cr, 4% Mo, 2% Ti, 3% Al, and 5% Co. Niobium was concentrated and separated on manganese dioxide, then determined photometrically using sulfochlorophenol S(3,6-bis[(5-chloro-2-hydroxy-3-sulfophenyl) azo]-4,5-dihydroxy-2,7-naphthalenedisulfonic acid). (J.G.B.)

25179 SPECTROPHOTOMETRIC DETERMINATION OF NEODYMIUM IN A MIXTURE WITH YTTRIUM. Poluektov, N. S.; Ovchar, L. A.; Ognichenko, S. F.; Lauer, R. S. (Inst. of General and Inorganic Chemistry, Odessa). Ind. Lab. (USSR) (Engl. Transl.); 37: No. 8, 1139-41(Aug. 1971).

Translated from Zavod. Lab.; 37: No. 8, 895-7(Aug 1971).

Conditions were established for the photometric determination of neodymium at concentrations of 0.25 to 70% in Y_2O_3–Nd_2O_3. A procedure was developed using bromopyrogallol (BPR) and nitrilotriacetic acid (NTA) for the determination of neodymium at concentrations between 0.25 and 20%; another was developed using Pyrogallol Red (PR) and sorbitol for Nd contents to 70%. The probable relative error in the analysis amounts to 0.4 to 5% with BPR and NTA and 0.3 to 5.4% with PR and sorbitol. (J.G.B.)

25180 SEPARATION OF THE STABLE ISOTOPES OF NEODYMIUM FROM IRRADIATED URANIUM FOR BURN-UP DETERMINATION. Krtil, J. (Nuclear Research Inst., Rez, Czech.); Bulovic, V.; Mencl, J.; Moravec, A. Radiochem. Radioanal. Lett.; 9: No. 5-6, 335-42(31 Mar 1972).

A two-column sequential procedure for the separation of neodymium isotopes from fission products is described. In the first step neodymium isotopes were separated from fission products and from the majority of rare earth elements on an anion exchanger with the aid of a HNO_3–CH_3OH mixture. The neodymium fraction was purified on a column of Chromosorb-W filled with di(2-ethylhexyl)phosphoric acid (DEHPA). (auth)

25181 CHEMISTRY OF GALLIUM. VII. COPRECIPITATION OF GALLIUM(III) WITH IRON(III) HYDROXIDE. Rafaeloff, R. (Soreq Nuclear Research Centre, Yavne, Israel). Radiochem. Radioanal. Lett.; 9: No. 5-6, 373-9(31 Mar 1972).

Radiochemical methods were used to determine the concentration of gallium(III) in extremely dilute solutions (1.4×10^{-7} M) by coprecipitation with iron(III) hydroxide at pH 6. (auth)

25182 SPECTROPHOTOMETRIC DETERMINATION OF ZIRCONIUM WITH METHYLXYLENOL BLUE. Deguchi, Masakazu; Kunishige, Tadao (Hiroshima Univ.). Jap. Anal.; 21: No. 3, 392-4(Mar 1972). (In Japanese).

Zirconium formed a red-violet complex with methylxylenol Blue (MXB) in weakly sulfuric acid solutions. This complex showed an absorption maximum at 575 nm, and the absorbance was constant over the acidity range from 0.18 to 0.28N (sulfuric acid). The calibration curve was linear for 5 to 60 μg of zirconium in 25 ml solution. The molar absorptivity was about 14,000. A sample solution containing 5 to 60 μg zirconium was mixed with suitable amounts of 1N sulfuric acid and 1.0 ml of 0.1% MXB, and made up to 25 ml with water (the final acidity 0.18 to 0.28N). It was then heated in a water bath of 55 ± 2°C for 3 minutes. After 5 minutes, the absorbance of the colored solution was measured at 570 nm against the reagent blank. Many ions did not interfere, but bismuth, hafnium, thorium, iron(III), and fluoride interfered even when their amounts were equal to that of zirconium. The permissible amounts of iron(III) were increased by addition of thioglycollic acid. (auth)

25183 METHODS FOR DETERMINING RHENIUM IN MOLYBDENITES. THE POLAROGRAPHIC DETERMINATION OF RHENIUM IN THE PRESENCE OF TRACES OF MOLYBDENUM. Duca, Alexandru; Calu, Cleopatra (Institut Polytechnique, Iasi). Rev. Roum. Chim.; 17: No. 1-2, 125-9(Jan-Feb 1972). (In French).

The separation, concentration, and determination of rhenium in molybdenites is described. The colorimetric determination of rhenium in the presence of small concentrations of molybdenum was reinvestigated. An extractive-polarographic variation in the determination of rhenium in molybdenites is presented as a method of control. The principal advantage of this variation consists in the specificity of the polarographic determination of rhenium in the presence of very small quantities of molybdenum. (tr-auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 25636, 26086, and 26097.

25184 (CEA-CONF-1824) FAST QUANTITATIVE MEASUREMENT OF RADIO ^{89}Sr AND ^{90}Sr IN MILK. Farges, L.; Jeanmaire, L.; Patti, F.; Laporte, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 16p. (In French). (SM-148; CONF-710705-6). Dep. NTIS (U. S. Sales Only).

From International symposium on rapid methods for measuring radioactivity in the environment; Munich, Germany (5 Jul 1971).

In case of an accident or incident at a nuclear installation, rapid assay of the ambient radiostrontium contamination is essential. Milk was selected as the typical sample medium. Ion exchange on a cationic resin is combined with a coprecipitation in order to isolate the radiostrontium. Differentiation between ^{89}Sr and ^{90}Sr is effected by absorption using Al shielding. (K.S.W.)

25185 (INR-1356) DETERMINATION OF THE AVERAGE $^{35}SO_2$ CONCENTRATION IN AIR. Chrzanowska, Ewa; Pszona, Stanislaw (Institute of Nuclear Research, Warsaw (Poland)). 1971. 19p. Dep. NTIS (U. S. Sales Only).

The method for determination of the average $^{35}SO_2$ concentration in air is described. The method is based on selective absorption of SO_2 in solution, containing oxidant. Three ways of sample preparation for ^{35}S activity measurement were elaborated. The sensitivity of the method allows the average $^{35}SO_2$ concentration down to 0.01 MPC_a (maximum permissible concentration in air) to be determined. (auth)

25186 RADIOISOTOPE DETERMINATION OF THE SURFACE CONCENTRATIONS OF CALCIUM AND PHOSPHORUS ON HYDROXYAPATITE IN AQUEOUS SOLUTION. Kukura, M.; Bell, L. C.; Posner, A. M.; Quirk, J. P. (Univ. of Western Australia, Nedlands). J. Phys. Chem.; 76: No. 6, 900-4(16 Mar 1972).

The areas per PO_4^{3-} ion and Ca^{2+} ion on the surface of calcium hydroxyapatite [$Ca_{10}(OH)_2(PO_4)_6$] at the point of zero charge were found to be 33.1 ± 2.7 and 23 ± 2.1, respectively; these values are in reasonable agreement with those expected from crystal parameters. The presence of PO_4^{3-} (or its hydrolysis products) Ca^{2+} Na^+, K^+, $CHCl_3$, or barbiturate ion in suspension of hydroxyapatite did not alter the area per PO_4^{3-} or Ca^{2+}. These areas did however change with pH. At pH values sufficiently less than 7.5 the area per PO_4^{3-} ion decreased. (auth)

25187 SEPARATION OF $BiPO_4$ CARRIED ACTINIDES BY BiOCl PRECIPITATION. Iyer, R. S.; Kamath, P. R. (Bhabha Atomic Research Center, Bombay). Microchem. J.; 17: No. 1, 105-8(Feb 1972).

A study was carried out to evolve a rapid determination of U, Th, Pu, and Am sequentially in a single urine sample. The actinides are precipitated with $BiPO_4$ and the hydrolysis method used for separation. (M.C.G.)

25188 SOME DETECTION METHODS IN RADIOCHROMATOGRAPHY AND THE MEASUREMENT OF TRITIUM AND OTHER LOW ENERGY β-EMITTERS. Prydz, S. Oslo; Oslo University (1971). 118p.

Thesis.

Reprints of ten articles resulting from a program to establish more sensitive and convenient methods for the detection and measurement of tracer activities in radiochromatography are given. The methods are adapted to paper and thin-layer separation as opposed to column separation procedures, and are largely aimed at tritium detection. Windowless gas-flow GM tubes and solid state particle detectors are not well adapted to such measurements. An attempt was made to use an electron multiplier and this seems very promising for further development. Otherwise the study has concentrated on scintillation techniques. Liquid scintillator techniques may involve loss of the sample and are expensive. However, among the solid scintillator materials tested were frozen liquid scintillators. The experimental procedures are described and commented upon and the separate articles summarized and discussed. (Norway)

25189 ANALYTICAL SYSTEM FOR SECONDARY ION MASS SPECTROMETRY IN ULTRA HIGH VACUUM. Huber, W. K. (Balzers Aktiengesellschaft fuer Hochvakuumtechnik und Duenne Schichten, Liechtenstein); Selhofer, H.; Benninghoven, A. J. Vac. Sci. Technol.; 9: No. 1, 482-6(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

A system for routine secondary-ion mass spectrometry (sputter-ion mass spectrometry) under uhv conditions has been developed. Positive as well as negative ions released from metals, semiconductors, and insulators can be measured. The system can be used for monolayer analysis (with low primary intensities) and for profile measurements in thin films. Electron-induced desorption investigations are possible with the same arrangement. Means are provided to combine the secondary-ion analysis with Auger spectrometry. A multitarget array allows up to 12 samples to be measured. The analytical system consists of a primary ion gun, a charge-neutralizing electron source, and a specially modified-quadrupole mass spectrometer. Fast pulse counting technique is used for the ion detection. The uhv system is pumped by a turbomolecular pump, a liquid nitrogen-cooled trap, and a titanium sublimation pump. Pressures in the 10^{-11} torr range can be obtained. In a number of typical examples, the versatility of the instrument is demonstrated. (auth)

25190 QUICK DETERMINATION OF THE AVERAGE NUMBER $\bar{Z}$ BY X-RAY SCATTERING. Kunzendorf, H. (Atomic Energy Commission Research Establishment, Risoe, Denmark). Nucl. Instrum. Methods; 99: No. 3, 611-12(1972).

X-ray scattering ratio measurements are proposed for a quick determination of the average atomic number of rock powders. (3 figures) (auth)

25191 INFLUENCE OF STATISTICAL ERROR IN RADIOACTIVITY COUNTING ON THE PRECISION OF ISOTOPE DILUTION ANALYSIS. I. Kyrs, M.; Vrana, T. (Middle East Technical Univ., Ankara). J. Radioanal. Chem.; 10: No. 1, 105-16(Feb 1972).

The influence of statistical error in measuring radioactive samples in direct isotope dilution analysis was analytically studied for several practically important sets of conditions. Formulas are given to calculate the optimum amount of radioactive substance to be added in order to minimize the error involved. Both cases with negligible background count rates and cases where the background must be considered are treated. In some cases recommendations are given for the times of measurement of background, undiluted and diluted samples. (auth)

25192 SEPARATION OF ZIRCONIUM, NIOBIUM, CERIUM, AND RUTHENIUM ON CHITIN AND CHITOSAN COLUMNS FOR THE DETERMINATION OF CESIUM IN NUCLEAR FUEL SOLUTIONS. Muzzarelli, R. A. A. (Univ., Bologna); Rocchetti, R.; Marangio, G. J. Radioanal. Chem.; 10: No. 1, 17-25(Feb 1972).

Nuclear fuel solutions at pH = 2.5 can be passed through 7 × 1 cm chitin or chitosan columns to fix the Zr, Nb, Ce, and Ru radioisotopes. This rapid and quantitative separation clears the γ spectrum of the solution from the main activity contribution and leaves the ^{137}Cs spectrum alone for accurate Cs determination. The process can be extended to radioactive waste waters. (auth)

25193 EXAMINATION OF SOME BINARY MIXTURES BY INELASTIC NEUTRON SCATTERING WITH A RADIOISOTOPE NEUTRON SOURCE. Pierce, T. B.; Boswell, C. R.; Haines, K. (Atomic Energy Research Establishment, Harwell, Eng.). J. Radioanal. Chem.; 10: No. 1, 83-8(Feb 1972).

Magnesium, aluminum, and iron were determined in sand at levels of >1% by inelastic neutron scattering. Neutrons were obtained from a 1-Ci polonium–beryllium neutron source and analytical determination was based on measurement of the characteristic γ-lines emitted during nuclear de-excitation. (auth)

25194 RADIOMETRIC METHODS OF CONTROL OF LABELED ORGANIC COMPOUNDS DURING PREPARATION, STORAGE, AND APPLICATION. Tykva, R. (Inst. of Organic Chemistry and Biochemistry, Prague). Radioisotopy; 12: No. 5, 737-56(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

The determination of ^{3}H and ^{14}C in gas chromatography is described, together with the relationships observed when determining the optimal conditions for the assay of ^{14}C in liquid chromatography, a procedure elaborated for simultaneous determination of ^{3}H and ^{14}C in paper chromatography, thin layer or gel electrophoresis, conditions of estimation for autoradiographic control of ^{3}H during preparation and storage of tritiated substances, and a fundamentally new method of estimation of planar distribution of radionuclides called semiconductography. (auth)

25195 RADIO-GAS CHROMATOGRAPHY OF SOME HIGHLY ACTIVE PYRIMIDINE BASES LABELED WITH ^{14}C. Pacakova, V. (Charles Univ., Prague); Matucha, M. Radioisotopy; 12: No. 5, 757-65(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

The gas-liquid chromatography (GLC) of silylated uracil, thymine, cytosine, 5-fluorouracil, and 5-bromouracil labeled with ^{14}C was studied. Combustion on CuO and gas proportional counting were used for the simultaneous activity measurement. Water solutions of bases (specific activity about 50 mCi/mM) were evaporated, dried and converted to their trimethylsilyl derivatives. A pseudoactivity effect was observed at higher concentrations of the analyzed compounds. Radio-gas chromatography (combustion method of the pyrimidine bases labeled with ^{14}C offers some advantages: the speed, reproducibility and increasing in sensitivity of analysis in comparison with other chromatographic methods. (auth)

25196 RADIO-GAS CHROMATOGRAPHY OF ^{14}C-LABELED HIGHER FATTY ACIDS OF THE RADIOACTIVE CULTIVATED ALGA CHLORELLA VULGARIS. Zilka, L.; Matucha, M.; Svihel, K. (Inst. for Research, Production, and Uses of Radioisotopes, Prague). Radioisotopy; 12: No. 5, 767-78(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

Higher fatty acids (C_{11} to C_{20}) from lipids of Chlorella vulgaris were analyzed by gas chromatography on two stationary phases (polar and nonpolar). In addition to the major acids (16:0, 18:1, 18:2, 18:3) the most of the acids with a relative abundance higher than 0.5% were identified. The lipids of Chlorella contain even number straight chain saturated, mono-, di-, and triunsaturated acids (14, 16, 18, and 20) and saturated acids with odd numbers of carbon atoms in the molecule (15, 17, and 19). For analytical control of the radiochemical purity of ^{14}C-labeled higher fatty acids isolated from the alga Chlorella vulgaris (cultivated in $^{14}CO_2$ atmosphere) radiogas chromatography was applied. The suitability of the type of stationary phase used for the individual preparations is discussed and the possibilities of this method (speed, sensitivity, and reproducibility) are shown. (auth)

25197 PROBLEM OF MEASURING IN EMULSIONS IN LIQUID SCINTILLATION COUNTING. Szarvas, T.; Oemboely, Cs.; Vegh, G. (Inst. of Isotopes, Budapest). Radioisotopy; 12: No. 5, 779-94(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

The problems of emulsion counting are discussed. Special reference is made to the importance of system structure and of the saturation end point. With real solubilizers precise radioactivity measurements of HTO or water solutions are only possible in those cases where less amount of water is solubilized than necessary to reach the saturation end point. Most of the investigations were carried out in an aerosol Ma–toluene–water solubilization systems. (auth)

25198 COMPARISON OF COUNTING EFFICIENCY FOR SCINTILLATORS BASED ON TOLUENE AND TOLUENE WITH TRITON X-100, APPLIED TO ACTIVITY MEASUREMENTS OF ^{14}C AND ^{3}H LABELED COMPOUNDS. Radoszewski, T.; Terlikowska, T. (Inst. of Nuclear Research, Swierk, Poland). Radioisotopy; 12: No. 5, 795-806(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

The application of a scintillator based on toluene and triton X-100 for measurements of low energetic beta emitters in comparison with pure toluene scintillator is presented. Toluene–triton scintillant makes possible direct measurement of aqueous samples. The counting efficiency as a function of the toluene–

triton ratio and the amount of water was determined for tritium added to the system in the form of tritiated water. Thus the most advantageous composition was found. The counting efficiency was plotted against the toluene–triton ratio in a given amount of water. Also the counting efficiency versus the amount of water introduced to constant toluene–triton ratio scintillant and pure toluene scintillant respectively is discussed. The highest counting efficiency for aqueous samples was found when using toluene–triton scintillant. (auth)

Separation Procedures

Refer also to abstracts 25357, 25400, and 25966.

25199 (CONF-720204–1) EXTRACTION OF MOLYBDENUM FROM ORES BY ELECTROOXIDATION. Technical Progress Report 47. Scheiner, B. J.; Lindstrom, R. E. (Bureau of Mines, Reno, Nev. Reno Metallurgy Research Center). Jan 1972. 11p.

From 101st annual meeting of the American Institute of Mining, Metallurgical, and Petroleum Engineers; San Francisco, Calif. (20 Feb 1972).

Extraction of molybdenum from molybdenite ore by an electrolytic oxidation procedure was investigated by the Bureau of Mines. Various parameters affecting molybdenum extraction, such as salt concentration, temperature, treatment rate, current density, and particle size, were studied. Molybdenum extraction of 95.2% was achieved on a laboratory scale from an ore containing 0.35% molybdenite. Corresponding power consumption was 24 kwh per pound of molybdenum extracted with a base consumption of 4.5 pounds of sodium carbonate. Laboratory and pilot plant experiments are in progress on low-grade molybdenum concentrates containing rhenium and copper. Preliminary results indicated that molybdenum extractions in the 90 to 99% range and rhenium extractions of 95 to 99% can be obtained without appreciable oxidation of associated copper minerals. (auth)

25200 (IS–2382) CORRELATING MULTICOMPONENT EQUILIBRIUM DATA FOR THE EXTRACTION OF LANTHANIDES WITH DI(2-ETHYLHEXYL)PHOSPHORIC ACID AS THE SOLVENT. Ioannou, Tom K.; Bautista, Renato G.; Smutz, Morton (Ames Lab., Iowa). [1970]. 21p. (CONF-710417–5). Dep. NTIS.

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971).

Single-component equilibrium data, obtained in previous work, were correlated empirically for the systems MCl_3–HCl–H_2O–1 M D2EHPA (in Amsco Odorless Mineral Spirits), where M designates Sm, Nd, and Ce. The nonlinear models predict the organic concentration as a function of the aqueous lanthanide concentration and acidity over a wide range. Equilibrium data for the systems $SmCl_3$–$NdCl_3$–HCl–H_2O–1 M D2EHPA–Amsco and $SmCl_3$–$NdCl_3$–$CeCl_3$–HCl–H_2O–1 M D2EHPA–Amsco, obtained in previous work, were also correlated empirically. The model for the binary system predicts the total organic concentration as a function of mole fraction of Sm in the aqueous phase and acidity, at total aqueous lanthanide concentrations of ~0.64 and 0.11 M. The ternary system model predicts the total organic concentration as a function of mole fraction of Ce and acidity, at three different mole fractions of Sm on a cerium-free basis (0.1, 0.5, and 0.9) and at a total aqueous concentration of ~0.64 M. The above models consist of a series of linear terms analogous to Raoult's Law for ideal solutions and a series of nonlinear terms predicting the deviations from ideality (interaction effects). (auth)

25201 (IS–2586) EXTRACTION OF SOME RARE EARTH ELEMENTS WITH DI(2-ETHYLHEXYL)PHOSPHORIC ACID AT HIGH ACIDITIES. Michelsen, O. B. (Ames Lab., Iowa); Smutz, M. (Institutt for Atomenergi, Kjeller (Norway)). [1970]. 11p. (CONF-710417–6). Dep. NTIS.

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971).

Distribution coefficients as a function of acidity were determined for Y, Ho, and Er in a chloride–DEHPA system and also in a nitrate–DEHPA system. In both systems the distribution coefficients are shown to go through minimum values at acidities ~7N. Separation factors decreased at higher acidities with the exception of the Er/Y separation factor in the chloride system, which shows a significant increase. The result was used to demonstrate a separation of Y from Ho and Er employing chromatography and elution at different acidities. Determination of distribution coefficients for Y, Er, and Yb in a sulfate–DEHPA system also gave minimum values, but at much higher acidities than in the other systems, ~16N acid. Results for Yb indicate that this element may be recovered from DEHPA solutions through back extraction with suitable concentrations of H_2SO_4. The separation factor for Yb/Er seems to be significantly higher than previously reported values for extractions with DEHPA. (auth)

25202 (RT/CHI–(71)16) FISSION PRODUCTS ANALYSIS BY MEANS OF CHEMICAL FILTER: THE TIN PHOSPHATE. Cesarano, C.; Marangio, G.; Serafini, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 10 Nov 1971. 24p. (In Italian). Dep. NTIS (U. S. Sales Only).

Chemical filters offer possibilities for the analysis of fission products. Tin phosphate was studied for the separation (filtration) of Zr, Nb from a mixture of other fission products (Cs, Ce, Ru) and the results obtained are presented and discussed. Some of them show promising possibilities for practical utilization. (auth)

25203 (UJV–2674-Ch) CALCULATION OF THE SORPTION KINETICS OF A RADIOACTIVE MICROCOMPONENT ON AN ION EXCHANGER IN THE PRESENCE OF A COMPETITIVE MACROCOMPONENT UNDER DYNAMIC CONDITIONS. Uher, E.; Berak, L. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1971. 69p. (In Czech). Dep. NTIS (U. S. Sales Only).

Formulas for the breakthrough curve of a dissolved ionic species on an ion exchanger are reviewed. Rosen's formula, derived for the case of the non-competitive ionic exchange, was further developed by substituting the equilibrium and kinetic relations previously derived so as to cover the case of a competitive sorption. The system containing Sr^{2+} as the microcomponent and Fe^{3+} as the macrocomponent (in constant concentration of H^+ ions) was used as a model on which the derivations were developed. A simple equation describing the breakthrough curve resulted for the case in which the distribution coefficient of the sorbed microcomponent was greater than that of the competing macrocomponent. In the reverse case the breakthrough curve ran through a maximum, and the exact analytical formula could be derived for certain special cases only. If applicable, the derived formulas can be used by simple numerical processing of the experimental data with a slide rule. (auth)

25204 METHOD AND APPARATUS FOR THE CONTINUOUS SEPARATION OF PLUTONIUM FROM URANIUM IN THE TWO-PHASE SYSTEM BY MEANS OF ELECTROLYTIC REDUCTION. (to Gesellschaft fuer Kernforschung mbH). British Patent 1,264,921. 23 Feb 1972. Priority date 5 Feb 1969, Germany.

Uranium(VI) and Pu(IV) contained in a two-phase (organic/aqueous) system were separated by electrolytically reducing the Pu(IV) to Pu(III) during the extraction. The Pu(III) transfers to the aqueous phase while the U(VI) remains in the organic phase. Ti metal was used as a cathode, and Pt coated with Ta, Ti, or Nb served as the anode. (B,L.M.)

25205 SOLVENT EXTRACTION OF SOME ACTINIDES BY TRILAURYLAMINE OXIDE. Maksimovic, Z. B.; Puzic, R. G. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). J. Inorg. Nucl. Chem.; 34: No. 3, 1031-8(Mar 1972).

The solvent extraction of uranium(VI) from nitric or hydrochloric acid and plutonium(IV) and thorium(IV) from nitric acid by trilaurylamine oxide (TLAO) in benzene or xylene was studied. A very high distribution of uranium(VI) in low acid media was observed. An examination of the mechanism of extraction of U(VI) was made using ir and NMR measurements. Two mechanisms of extraction of uranium(VI) in low and high acid media are postulated. (auth)

25206 SOLVENT EXTRACTION OF SOME DIPROTIC NITRO-AROMATIC ACIDS AND OF THEIR COMPLEXES WITH SOME ACTINIDES. III. EXTRACTION OF TETRAVALENT PLUTONIUM AND THORIUM 3-NITRO-p-CRESOL-5-SULPHONATE COMPLEXES WITH TRIBUTYL PHOSPHATE. Beran, M. (Nuclear Research Inst., Rez, Czech.). J. Inorg. Nucl. Chem.; 34: No. 3, 1043-52(Mar 1972).

The extraction of tetravalent plutonium and thorium from 1M(H,Na)Cl aqueous solution containing 3-nitro-p-cresol-5-sulphonic acid (H_2A) with a n-dodecane solution of tributyl phosphate (TBP) at 25 ± 0.2°C was studied. The experimental data were explained in terms of following extractable complexes: $PuA(HA)Cl \cdot 3TBP$ and $PuCl_4 \cdot 2TBP$; $ThA(HA)Cl \cdot 2TBP$, $ThACl_2 \cdot 2TBP$, and $ThA_2 \cdot 2TBP$. The nitroaromatic complex, MA^{2+}, was found in the aqueous phase in addition to the chloride complex, MCl^{3+}, in both cases. The stability constants of these species were calculated. (auth)

25207 INVESTIGATIONS ON EXCHANGE PROCESSES OCCURRING ON SYNTHETIC ANION EXCHANGERS WITH THE HELP OF THE RADIOACTIVE INDICATOR METHOD. I. KINETICS OF EXCHANGE OF CARRIER-FREE RADIOACTIVE MATERIALS. Madi, Istvan; Varro, Tibor. Magy. Kem. Foly.; 77: No. 8, 408-16(Aug 1971). (In Hungarian).

The temporal course of ion exchange of radioactive substances ($^{212}Pb^{2+}$, $^{144}Ce^{3+}$, $^{90}Y^{3+}$) on the weak acid ion exchanger Amberlite-IRC-50 was studied. Results showed that the rate of exchange was

determined by both film and particle diffusion. A special autoradiographic method, by means of which diffusion of radioactive substances could be followed in the interior of the resin, was developed. Evaluation of these autoradiograms permitted determination of diffusion coefficients characterizing ion diffusion in the interior of resin particles. Studies of simultaneous exchange of radioactive substances demonstrated that infinitely small amounts of $^{212}Pb^{2+}$ and $^{144}Ce^{3+}$ did not affect their mutual exchange; this finding was true with respect to kinetics as well as to the distribution coefficients characterizing the final state of exchange. (tr-auth)

25208 INVESTIGATION OF OXALATE COMPLEXES OF ZIRCONIUM AND HAFNIUM. Pyatnitskii, I. V.; Kravchenko, T. I. (Kiev State Univ.). Ukr. Khim. Zh.; 37: No. 10, 1054-7(Oct 1971). (In Russian).

Oxalic acid is used for desorbing from cation exchange resins and for partial separation of Zr and Hf; the study was made to elucidate the composition and stability of the complexes formed. Equilibria between Zr and Hf hydroxides and oxalic acid solutions were investigated by a solubility method. Within the limits of pH of 5.2 to 4.0 Zr and Hf oxalate complexes both possess the formula $MeO(C_2O_4)_2^{2-}$, with stability constants of 2.1×10^{-9} and 3.0×10^{-7}, respectively. (K.S.W.)

25209 SEPARATION OF TITANIUM FLUORIDE AND NIOBIUM FLUORIDE FROM GASEOUS URANIUM HEXAFLUORIDE CONTAINING SAME. Anderson, Lowell W.; Stephenson, Michael J. (to United States Atomic Energy Commission). U. S. Patent 3,625,661. 7 Dec 1971. Filed 11 Aug 1969.

This invention relates to a method of selectively removing titanium or niobium values from a gaseous mixture of uranium hexafluoride and niobium pentafluoride or titanium tetrafluoride by passing the mixture through a bed of pelletized complex fluoride at a temperature in the range of 200 to 400°F. (Offic. Gaz.)

25210 CHROMATOGRAPHIC SEPARATION OF MOLYBDENUM USING AN ALIPHATIC α-HYDROXY OXIME. Fritz, James S.; Beuerman, Donald R. (Ames Lab., Iowa). Anal. Chem.; 44: No. 4, 692-4(Apr 1972).

Each of two aliphatic α-hydroxy oximes in toluene solution is shown to extract molybdenum(VI) selectively from acidic aqueous solutions. Plots of distribution ratio as a function of pH and of oxime concentration, together with NMR and ir data, were used to elucidate the structure of the extracted complexes. Using these oximes in column extraction chromatography, molybdenum(VI) was separated quantitatively from each of 10 different metal ions, including tungsten(VI). Several standard steel samples were analyzed successfully for molybdenum using the chromatographic separation. (auth)

25211 SYNERGISTIC EFFECTS IN ION EXCHANGE IN MIXED SOLVENTS: CHLORIDE MEDIA. Rao, A. P.; Dubey, S. P. (Indian Inst. of Tech., Delhi). Contract AT(30-1)-2623. Anal. Chem.; 44: No. 4, 686-91(Apr 1972).

The anion-exchange behavior of Co(II), Cu(II), and UO_2(II) in ketone–alcohol–HCl mixtures was studied using Dowex 1-X8. The synergistic enhancement of Kd values while using mixtures of two solvents was attributed to increased formation of the species undergoing exchange equilibria in the mixture as compared to the individual solvents. From the absorption spectral measurements, the species taking part in the exchange equilibria are shown to be $CoCl_3^-$, $CuCl_3^-$, and UO_2Cl_2 in the solution phase. They are present as $CoCl_3^-$, $CuCl_4^{2-}$, and as a mixture of UO_2Cl_2 and $UO_2Cl_3^-$ on the resin. (auth)

25212 ION EXCHANGE IN NONAQUEOUS AND MIXED MEDIA. Heumann, Walter R. (Univ. of Montreal). CRC Crit. Rev. Anal. Chem.; 2: No. 3, 425-59(Nov 1971).

A review on ion exchange in nonaqueous and mixed media is presented that updates earlier reviews and deals in particular with certain aspects of the field that are of interest to the analytical chemist, such as the exchange of organic ions, but that have not been covered sufficiently in earlier reviews. (D.H.M.)

25213 SALTING-OUT IN EXTRACTION SYSTEMS. Frolov, Yu. G.; Nasonova, G. I. (Inst. of Chemical Tech., Moscow). pp 50-5 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417–(Vol.1 and 2).

The effect of salting-out agents on the extraction of sulphuric acid with N-octylaniline and the separation of uranium and thorium using tri-n-octylamine is discussed. For the bisulphate salting-out agents used for sulphuric acid the effect decreased in the order lithium bisulphate > sodium bisulphate > ammonium bisulphate. The system $UO_2(NO_3)_2$–$Th(NO_3)_4$–TOA–$LiNO_3$ is used to show that the separation of uranium and thorium is influenced by all the salting-out effects. 11 references. (auth)

25214 EXTRACTION OF EUROPIUM FROM SULPHATE–PERCHLORATE SOLUTIONS BY DI-2-ETHYLHEXYLPHOSPHORIC ACID. Cassidy, P. W.; Burkin, A. R. (Imperial Coll. of Science and Tech., London). pp 476-82 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417–(Vol.1 and 2).

The extraction of europium from sulphate–perchlorate solutions by bis(2-ethylhexyl) phosphate, $(HX)_2$, was analyzed quantitatively in terms of the equation: $\log D_{Eu} = \log K'_{Eu} + 3 \log [(HX)_2] + \log \alpha_0 + 3$ pH where $D_{Eu} = [Eu(HX_2)_3]_{org}/[\Sigma Eu]_{aq}$; $K'_{Eu} = [Eu(HX_2)]_{org}\{H^+\}^3_{aq}/[Eu^{3+}]_{aq}[(HX)_2]^3_{org} - \log \{H^+\} = $ pH and $\alpha_0 = [Eu^{3+}]_{aq}/[\Sigma Eu]_{aq}$. Values of K'_{Eu} are given for initial sulphate concentrations between 0.00 and 0.30 molar. 10 references. (auth)

25215 SOLVENT EXTRACTION OF YTTRIUM AND LANTHANIDES WITH N-BENZOYL-N-PHENYLHYDROXYLAMINE. Fouche, K. F.; Le Roux, H. J. (Univ. of the Orange Free State, Bloemfontein, South Africa). pp 499-504 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417–(Vol.1 and 2).

A systematic investigation of the extraction of yttrium and all the lanthanides with N-benzoyl-N-phenylhydroxylamine (HBPHA) showed that a plot of the concentrations of HBPHA giving equal distribution constants versus the inverse of the ionic radius or atomic number, results in the formation of four tetrads. The antagonistic effect of tri-n-butyl phosphate (TBP) on the extraction of thulium with HBPHA from benzene was quantitatively shown to be due to the formation of the association product HBPHA · TBP. 30 references (auth)

25216 ACIDIC ORGANOPHOSPHORUS EXTRACTANTS. XV. EXTRACTION OF AMERICIUM AND SOME FISSION PRODUCTS BY DI-(2-ETHYLHEXYL)PHOSPHORIC ACID FROM PERCHLORATE AND CITRATE MEDIA. Kolarik, Z. (Kernforschungszentrum, Karlsruhe, Ger.). pp 753-61 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417–(Vol.1 and 2).

The distributions of Am(III), Eu(III), Ce(III), Sr(II), Zr(IV), and Nb(V) were measured between solutions of bis(2-ethylhexyl) phosphate in n-hexane and aqueous perchlorate and perchlorate–citrate solutions. Am(III) and trivalent lanthanides can be separated from Sr(II) and Nb(V) at $-\log [H^+] = 2-3$ with an aqueous citrate concentration of 0.25_M; separation from Zr(IV) can be achieved by introducing nitrilotriacetic acid into the aqueous phase and/or by using short phase-contact times. If M represents Am, Eu and Ce, and HA the monomeric molecule of the extractant, the composition of the complexes prevailing in the organic phase both in the presence and absence of citrates in the system can be written as $MA_3 \cdot 3HA$ and $SrA_2 \cdot 4HA$. 12 references. (auth)

25217 SOLVENT EXTRACTION OF SOME DIPROTIC NITROAROMATIC ACIDS AND THEIR COMPLEXES WITH SOME ACTINIDES BY TRIBUTYL PHOSPHATE. Secerov, M. M.; Kopecni, M. M.; Maksimovic, Z. B.; Beran, M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade. Inst. of Nuclear Research, Rez, Czech.). pp 762-7 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417–(Vol.1 and 2).

Solvent extraction of 3,5-dinitrosalicylic, 5-nitrosalicylic, and 4-nitrophenol-2-sulphonic acids and of their Pu^{4+} and UO_2^{2+} complexes from 1M-(H,Na)Cl medium with tributyl phosphate in n-dodecane was investigated. The composition of the predominant extractable species was determined by slope analysis. The possible utilization in separation processes is discussed in general terms. 2 references. (auth)

25218 CAPRIC ACID EFFECT ON ACTINIDE EXTRACTION BY TRILAURYLAMMONIUM NITRATE. Koehly, G.; Madic, C.; Berger, R. (CEN, Fontenay-aux-Roses, France). pp 768-80 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417–(Vol.1 and 2).

A decrease of the Am(III), Np(IV)–Pu(IV), and U(VI) distribution coefficients between organic solutions of trilaurylammonium

nitrate and nitrate media was observed when capric acid was added to the organic phase, and a systematic study of this negative synergistic effect was undertaken. This included a review of the capric acid extracting properties and the effect on trilaurylamine extraction of the actinide elements at the III, IV, and VI oxidation state. A tentative explanation of the extraction mechanism is proposed, and the association constant of the $R_3N\ HNO_3\ (\overline{HA})_2$ complex is calculated in the case of tetravalent species. $\overline{K}$ was found to be 0.0287 ± 0.0023 and $p\overline{K}$ 1.452. 10 references. (auth)

25219 SYNERGISTIC EXTRACTION AND ITS USE IN ANALYTICAL CHEMISTRY OF TRANSPLUTONIUM ELEMENTS. Myasoldov, B. F.; Chmutova, M. K.; Lebedev, I. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). pp 815-19 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The synergistic effect was investigated in the extraction of transplutonium elements in systems consisting of chelate-forming reagents with donor-active additives, and such systems were used for the separation and extraction of these elements from relatively acid media. 1-Phenyl-3-methyl-4-benzolpyrazolone-5 (PMBP) was used as chelate · forming reagent and alcohols and neutral phosphoro-organic reagents (tributyl phosphate, trioctylphosphine oxide, tributylphosphine oxide) were used as donor-active additives. Some results are given for the dependence of Am, Cm, Bk, and Eu extraction on the TBP and trioctylphosphine oxide concentration in cyclohexane, the influence of the solvent nature on Am(III) extraction in the system PMBP–TBP–solvent–0.1M HNO_3, the dependence of Am extraction by a mixture of 0.05 M PMBP, 0.25M TBP and 0.25M TBP in cyclohexane on the concentration of salts in the water phase, and Cm(III) and Am(V) extraction by a mixture of 0.05M PMBP + 0.025M trioctylphosphine oxide in cyclohexane. Some data are also given on the relevant absorption spectra of Am in 0.1M HNO_3. 0 references (UK)

25220 EFFECT OF CHEMICAL REACTION ON THE RATE OF SOLVENT EXTRACTION. Nakashio, F.; Tsuneyuki, T.; Inoue, K.; Sakai, W. (Kyushu Univ., Fukuoka). pp 831-9 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

In order to show how the interfacial reaction can influence the rate of extraction on the extraction of uranium nitrate by a drop of tricresyl phosphate, and of hydrochloric acid by a drop of Amberlite LA-2 was carried out. Experimental results for uranium nitrate were interpreted by a one dimensional diffusion model; the interfacial reaction had no effect on the extraction rate during drop formation, but a slight effect during drop rising. In the case of HCl, experimental results were interpreted by a one dimensional diffusion model during drop formation but by the Newman model (Trans. Amer. Inst. Chem. Engrs. 27: 310(1931)) during drop rising; it was found that the rising drop behaves like a rigid sphere with an effective diffusivity larger than the molecular diffusivity. 9 references (auth)

25221 EXTRACTION OF SOME RARE EARTH ELEMENTS WITH DI-(2-ETHYLHEXYL)PHOSPHORIC ACID AT HIGH ACIDITIES. Michelsen, O. B.; Smutz, M. (Iowa State Univ., Ames. Institutt for Atomenergi, Kjeller, Norway). pp 939-49 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

Distribution coefficients as a function of acidity were determined for Y, Ho, and Er in a chloride–bis(2-ethylhexyl) phosphate (D2EHPA) system and also in a nitrate–D2EHPA system. In both systems the distribution coefficients were shown through minimum values at acidities ~7N. Separation factors tend to decrease at the higher acidities with the exception of the Er/Y separation factors in the chloride system, which shows a significant increase. The result was used to demonstrate a separation of Y from Ho and Er employing chromatography and elution at different acidities. Determination of distribution coefficients for Y, Er, and Yb in a sulphate–D2EHPA system also gave minimum values, but at much higher acidities than in the other systems (~16N acid). Results for Yb indicate that this element may be recovered from D2EHPA solutions through back extraction with suitable concentrations of H_2SO_4. The separation factor for Yb/Er seems to be significantly higher than previously reported values for extractions with D2EHPA. 12 references (auth)

25222 POLYMERS OF IRON AND RARE EARTHS AND DI-(2-ETHYLHEXYL)PHOSPHORIC ACID. Harada, T.; Smutz, M.; Bautista, R. G. (Ames Lab., Iowa). pp 950-6 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

Bis-(2-ethylhexyl) phosphate, (D2EHPA), [HG as monomer, $G = (C_4H_9 \cdot CH(C_2H_5) \cdot CH_2)_2PO_4^-$], forms a polymer $(MG_3)_n$ with the rare earths. The conditions under which the rare earth polymer are formed were studied as a function of initial D2EHPA concentration C_I, final acidity H, and final aqueous concentration of the metal. When C_I was less than 1.5M, the formation of polymer occurred at a ratio of D2EHPA to metal concentration of less than 6.5. The minimum organic metal concentration for polymer formation was found to be different for each rare earth and yttrium at aqueous metal concentrations of more than 0.2M. The molecular weight of the polymer, determined by a viscosity method, gave a degree of polymerization n, of 4000 for Y, Ho, etc., 600 for La and Yb, and 3 for Fe(III). X-Ray powder diffraction of the polymers showed well defined x-ray lines, indicating a high degree of order in the crystals. The polymer is soluble in a mixture of benzene and cyclohexane, but decomposes in concentrated HCl, HNO_3 and H_2SO_4 at room temperature and in 2M HCl at its boiling point. 23 references (auth)

25223 CORRELATING MULTICOMPONENT EQUILIBRIUM DATA FOR THE EXTRACTION OF LANTHANIDES WITH DI-(2-ETHYLHEXYL)PHOSPHORIC ACID AS THE SOLVENT. Ioannou, T. K.; Bautista, R. G.; Smutz, M. (Ames Lab., Iowa). pp 957-65 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From international solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

Single-component equilibrium data, obtained in previous work, were correlated empirically for the systems MCl_3–HCl–H_2O–1 M-D2EHPA (in Amsco Odorless Mineral Spirits), where M designates Sm, Nd, and Ce. The nonlinear models predict the organic concentration as a function of the aqueous lanthanide concentration and acidity over a wide range. Equilibrium data for the systems $SmCl_3$–$NdCl_3$–HCl–H_2O–1 M-D2EHPA–Amsco and $SmCl_3$–$NdCl_3$–$CeCl_3$–HCl–H_2O–1 M-D2EHPA–Amsco, obtained in previous work, were also correlated empirically. The model for the binary system predicts the total organic concentration as a function of mole fraction of Sm in the aqueous phase and acidity, at total aqueous lanthanide concentrations of ~0.64M and 0.11M. The ternary system model predicts the total organic concentration as a function of mole fraction of Ce and acidity, at three different mole fractions of Sm on a cerium-free basis (0.1, 0.5 and 0.9) and at a total aqueous concentration of ~0.64M. The above models consist of a series of linear terms analogous to Raoult's Law for ideal solutions and a series of nonlinear terms predicting the deviations from ideality (interaction effects). 10 references. (auth)

25224 SOLVENT EXTRACTION FROM MOLTEN SALTS OF SOME 4f AND 5f ELEMENTS. Foos, J.; Guillaumont, R. (Laboratoire Joliot-Curie, Orsay, France). pp 966-73 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The extraction at 150°C of the lanthanides Sm, Eu, Gd, Tb, Dy, and the 5f elements Am, Cm, Bk and Cf, from a molten salt phase of $LiNO_3$–KNO_3 (3 : 4) by a solution of tributyl phosphate (TBP) or triphenylphosphine oxide (TPPO) in a eutectic of polyphenyls was investigated. The slopes found from plots of the logarithmic distribution coefficients of these elements vs. log free TBP concentration in the organic phase were 3 for Sm, Dy, Cf, 2 for Gd, Am, Cm, and 1.5 for Eu. The slopes found for the same log plots for TPPO were 2 for Sm, Dy, Am, Cm, Cf, 1.5 for Gd, and 1 for Eu. Terbium and berkelium could not be extracted from the melt. 20 references (auth)

25225 ACTINIDE–LANTHANIDE SEPARATION IN THE SYNERGISTIC SYSTEM KEROSENE–TRI-n-BUTYL PHOSPHATE–THENOYLTRIFLUOROACETONE. Davis, M. W. Jr.; Holt, J. W.; Tournier, R. A. (Univ. of South Carolina, Columbia). pp 974-92 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The data presented provide the basis for a nitrate-based solvent extraction system for the separation of the actinides from the lanthanides. Distribution coefficients were measured over a wide range of conditions. The aqueous phase consisted of dilute nitric acid and 10^{-3} M rare earth and the organic phase

contained concentrations of both tri-n-butyl phosphate (TBP) and thenoyltrifluoroacetone (HTTA). The distribution coefficients, q(org./aq.), for all elements studied could be varied from 10^{-3} to 10^{2} by varying the pH of the aqueous phase (range 1 to 3) as well as the concentrations of TBP and HTTA in the organic phase. From the relative values of the distribution coefficients Ce, Pr, and La can be split off in one solvent extraction cycle, while Sm can be split off in a second cycle. Nd will be the most difficult to separate. 31 references (auth)

25226 EFFECT OF A SECOND ORGANIC SOLVENT ON THE EXTRACTION OF TRIVALENT EUROPIUM BY ORGANOPHOSPHORUS ACIDS INTO BENZENE zur Nedden P. J.; Jamil, M.; Duyckaerts. G. (Univ., Liege). pp 993-1003 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The influence of a second organic solvent (e.g., ketone, carboxylic acid, alcohol, or phenol) on the extraction of Eu(III) by different organophosphorus acids was studied. The aqueous phase consisted of a 1M-(H, Na)ClO_4 solution at pH 1, and the main organic solvent was benzene. At low concentrations of the second solvent two mono-acidic extracting agents give rise to a decrease in the metal cation extraction, while di-acidic agents showed a synergistic effect. In the case of pentanol, more detailed studies were carried out. The influences of different factors such as the dielectric constant, the solvation and the distribution of the extracting agent, the stoichiometry and the solvation of the metal complexes are discussed for various mixtures of benzene–pentanol. 5 references (auth)

25227 INFLUENCE OF TEMPERATURE ON THE EXTRACTION OF LANTHANIDES IN THE HDEHP–HNO_3 SYSTEM. Fidelis, Irena (Inst. of Nuclear Research, Warsaw). pp 1004-7 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The extraction coefficients of some lanthanides in the bis-(2-ethylhexyl) phosphate (HDEHP)–HNO_3 system were measured over the temperature range 10 to 50°C and the influence of temperature on the separation factors of adjacent lanthanides was investigated. The results are of interest for estimation of the enthalpy, relative free energy, and entropy changes associated with the extraction process. Part of a general programme of investigation of the trends in thermodynamic functions associated with the extraction of lanthanides by organophosphorus ligands is described. 6 references (auth)

25228 CALCULATION OF COUNTER-CURRENT EXTRACTION OF LANTHANIDES WITH A DIGITAL COMPUTER. Goto, Totaro (Government Chemical Industrial Research Inst., Tokyo). pp 1011-24 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

Computer programmes for calculation of counter-current extraction were developed, and applied to the extraction system of a cation exchange D2EHPA (bis(2-ethylhexyl) phosphate)–$LaCl_3$–HCl as well as to that of an anion exchanger. Quatamin T-08 (a quaternary ammonium salt)–$Y(SCN)_3$–NH_4SCN. The experimental and calculated extractions of the lanthanide were in good agreement. The effects of extraction conditions such as stage number, feed composition etc., on the lanthanide extraction were investigated. A suggestion is offered for the possibility of producing highly pure yttrium by solvent extraction processes. 7 references (auth)

25229 AUTOMATIC CONTROL AND RESPONSE CHARACTERISTICS OF SMALL SCALE SOLVENT EXTRACTION EQUIPMENT. Mills, A. L.; Bell, P. G. (United Kingdom Atomic Energy Auhtority, Dounreay, Scotland). pp 1062-70 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

Automatic control of a solvent extraction process using simple feed back control loops was demonstrated. The process consists of two cycles of extraction, strip and backwash. The optimised flowsheet was computed off line by the SIMTEX system of solvent extraction programs. Determination of the response of a mixer–settler operating on a simple extraction flowsheet to a stepwise input showed the system to be approximately third order. The general form of the output response is given. The system employed was $UO_2(NO_3)_2$–TBP–HNO_3. 6 references (auth)

25230 DIALKYL SULPHOXIDES AND DIALKYL SULPHIDES AS NEW EXTRACTANTS FOR METALS. Mikhailov, V. A.; Torgov, V. G.; Gil'bert, E. N.; Mazalov, L. N.; Nikolaev, A. V. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). pp 1112-19 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

It was found that sulphoxides are effective extractants for all metals (including actinides), which can be extracted by TBP, but in all the cases studied, the extraction ability of sulphoxides was higher than that of TBP. Dialkyl sulphides are effective and specific extractants for Au, Ag, Pd, and Hg. One of the methods of studying metal–extractant interactions was by high resolution x-ray spectroscopy. 30 references. (auth)

25231 EFFECT OF THE STATES OF ZIRCONIUM AND HAFNIUM IN AQUEOUS SOLUTIONS ON THEIR SEPARATION BY LIQUID–LIQUID EXTRACTION. Yagodin, G. A.; Sinegribova, O. A.; Chekmarev, A. M. (Inst. of Chemical Tech., Moscow). pp 1124-33 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The main features of zirconium and hafnium separation are discussed. The preferable extraction of the elements into various extractants is determined by processes occurring in aqueous solutions. The maximum separation takes place when there is a difference in existence of zirconium and hafnium as hydrolysed or complex ions. 12 references (auth)

25232 DETERMINATION OF TRIBUTYL PHOSPHATE ASSOCIATION CONSTANTS AND AN APPROACH TO THE PROBLEM OF SOLVENT EFFECT. Petkovic, Dj. M.; Kezele, B. A. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 1137-41 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The association constants of tributyl phosphate (TBP) with benzene, carbon tetrachloride, methyl isobutyl ketone (MIBK), and chloroform were determined by infrared spectroscopy. These, together with TBP dimerisation constants taken from previous work, were used to calculate the concentration of unbonded TBP molecules in different TBP–diluent systems. For uranyl nitrate extraction by various TBP–diluent mixtures the uranyl nitrate distribution is proportional to the concentration of unbonded TBP molecules. The same relation can be used to obtain an approximate value of the TBP association constant for some other diluents, providing the distribution coefficient of the extracted species is known. 25 references (auth)

25233 LIQUID–LIQUID EXTRACTION OF URANYL NITRATE AND THORIUM NITRATE BY ALIPHATIC SULPHOXIDES: SEPARATION BY DI-N-HEPTYL SULPHOXIDE. Laurence, G. J.; Chaieb, M. T.; Talbot, J. (Laboratoire de Genie Chimique, Paris). pp 1150-60 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The preparation, principal properties, and reasons for using aliphatic sulphoxides in liquid–liquid extraction are given followed by optimum conditions for a thorium–uranium separation in acid medium. The sulphoxides are used as 1M solutions in 1,1,2-trichloroethane. Studies in the extraction of uranyl nitrate, $UO_2(NO_3)_2$, and thorium nitrate, $Th(NO_3)_4$, led to the choice of di-n-heptyl sulphoxide as the best solvent (DHpSO). Studies on the simultaneous extraction of uranium and thorium in neutral and acid media prove that a good separation is possible. A study of the mechanism shows the formation of $HNO_3 \cdot$ DHpSO, $UO_2(NO_3)_2 \cdot$ 2DHpSO, and $Th(NO_3)_4 \cdot$ 2DHpSO complexes. 10 references. (auth)

25234 SOLVENT EXTRACTION OF SOME ACTINIDES IN MIXED SOLVENTS TRILAURYLAMINE OXIDE/2-THENOYLTRIFLUOROACETONE SYSTEM. Puzic, R. G.; Maksimovic, Z. B. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 1180-7 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The solvent extraction of plutonium(IV), thorium(IV), and

uranium(IV) from nitric acid media with mixtures of the extractants trilaurylamine oxide (TLAO) and 2-thenoyltrifluoroacetone (TTA) in benzene was studied. In all cases synergistic effects were observed. The formulae of synergistic adducts were found to be $Pu(X)_3NO_3TLAO$, $Th(X)_3NO_3TLAO$ and $UO_2(X)_2TLAO$ (HX = TTA). The equilibrium constants of these are reported. 17 references (auth)

25235 METHYL DIPHENYL PHOSPHATE EXTRACTION EQUILIBRIA. Apelblat, A. (Israel Atomic Energy Commission, Beer Sheva). pp 1208-10 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

Extraction of water, mineral acids (HNO_3, HCl, H_2SO_4), uranyl nitrate, and thorium nitrate by methyl diphenyl phosphate (MDPP) is considered in detail. Thermodynamic analyses of the binary systems of MDPP with water, benzene, chloroform, carbon tetrachloride, methanol, ethanol, acetone, and hydrocarbons are presented. 4 references (auth)

25236 HIGHER SOLVATES OF NITRIC ACID WITH TRIBUTYL PHOSPHATE. Rozen, A. M.; Nikolotova, Z. I.; Markov, V. S.; Teterin, E. G. (Cybernetics Council, Moscow). pp 1440-9 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

From the data on low concentration nitric acid distribution and water distribution during TBP extraction of nitric acid it is shown that as well as the known unhydrated monosolvate $HNO_3 \cdot TBP$, hydrosolvates of the type $HNO_3 \cdot H_2O \cdot 2TBP$ and $HNO_3 \cdot NH_2O \cdot 3TBP$ (where N = 1 and, possibly, 4) are formed. Hydrosolvate formation is also confirmed by measurements of infrared spectra. The constants of hydrosolvate formation were found from the distribution data. It is shown that with their use the isotherm of acid extraction is described over a wide concentration range. The calculation shows that the hydrosolvate concentration reaches a maximum at X_H = 2.0 to 3.0 M, where X_H is the aqueous acid concentration, and at X_H = 7 M hydrosolvates are essentially substituted completely by monosolvate. The concentration of water in the organic phase also passes through a maximum. Owing to formation of higher solvates the concentration of free TBP is significantly lower than that determined on the assumption that only monosolvate is formed. This should be taken into account in quantitative treatment of data on extraction from nitric acid media. 6 references. (auth)

25237 GAS CHROMATOGRAPHY OF RARE EARTH PIVALOYLTRIFLUOROACETONE ADDUCTS WITH TRI-N-BUTYL PHOSPHATE AND TRI-N-OCTYLPHOSPHINE OXIDE. Utsunomiya, Kei; Shigematsu, Tsunenobu (Kyoto Univ.). Bull. Chem. Soc. Jap.; 45: No. 1, 303(Jan 1972).

Gas chromatograms of the adduct compounds of europium(III), erbium(III), and lutetium(III) with pivaloyltrifluoroacetone (HPTA) and tributyl phosphate (TBP), or with HPTA and trioctylphosphine oxide (TOPO) are presented. Results indicate that the rare earth–PTA adducts with TBP and TOPO can be gas-chromatographed without decomposition. (J.G.B.)

25238 RAPID SEPARATION OF CARRIER-FREE ^{95}Zr FROM ^{95}Nb USING MnO_2 COLUMN. Shukla, J. P.; Chandrasekharan, E. S.; Rengan, K. (Bhabha Atomic Research Center, Bombay). Separ. Sci.; 7: No. 2, 193-8(Apr 1972).

An efficient and simple method is presented for the radiochemical separation of ^{95}Zr from ^{95}Nb in a carrier-free state. ^{95}Zr is desorbed quantitatively from the MnO_2 column using a 3M HNO_3 + 0.05M HF solution. A decontamination factor higher than 10^5 is achieved. The radionuclidic purity of the separated ^{95}Zr was determined by gamma-ray energy measurements as well as by a radiochemical method. The entire procedure takes less than 20 min. (auth)

25239 DISTRIBUTION, RATE OF EXTRACTION, AND COMPLEXING ACTION OF THENOYLTRIFLUOROACETONE IN THE SYNERGISTIC SYSTEM KEROSINE/THENOYLTRIFLUOROACETONE/TRIBUTYL PHOSPHATE/DILUTE HNO_3. Tournier, R. A.; Davis, M. W. Jr. (Univ. of South Carolina, Columbia). Separ. Sci.; 7: No. 2, 159-86(Apr 1972).

A study of the variation of the distribution coefficients of thenoyltrifluoroacetone (HTTA) and Sm with time was made in the synergistic system kerosene–HTTA–tributyl phosphate(TBP)–dilute HNO_3. The results indicate that the phenomena of antagonism or antisynergism which takes place at TBP concentrations above 0.1M is due to the large reduction of the free HTTA-enol in the organic phase and to a much lesser extent to the reduction of the free TBP concentration in the same phase through the formation of $HTTA \cdot H_2O$ and $HTTA \cdot H_2O \cdot TBP$, respectively. Equations that allow calculation of the free HTTA-enol and free TBP were developed. (auth)

25240 SOLVENT EXTRACTION SEPARATION OF SELECTED TRANSITION METALS WITH MESITYL OXIDE. Shinde, V. M. (Shivaji Univ., Kolhapur, India). Separ. Sci.; 7: No. 2, 97-103 (Apr 1972).

Mesityl oxide (4-methyl-3-pentene-2-one) was used for the solvent extraction studies of some transition metals such as Th, Zr, U, Pd, Pt, V, Cr, Mo, W, Re, Fe, Au, and Ga. Optimum conditions for the extraction of the above metals are given based on a critical survey of the relevant factors such as the effect of acid concentration, reagent concentration, salting-out agent, period of extraction, and diverse ions. The mechanism underlying these extractions is also discussed. Mesityl oxide has proved to be an excellent extractant as it provides clean-cut separation of a large number of ions in minimum time. (auth)

25241 SEPARATION OF BERKELIUM(III) FROM CERIUM (III). Chudinov, E. G.; Pirozhkov, S. V. (Atomic Energy Inst., Moscow). J. Radioanal. Chem.; 10: No. 1, 41-6(Feb 1972).

Factors affecting the separation of Bk(III) and Ce(III) in liquid–liquid extraction by tertiary amines and quaternary ammonium compounds from neutral solutions of Li, Na, NH_4, and K nitrates were investigated. It has been found that the maximum separation factor is reached in the extraction from $NaNO_3$ solutions by solutions of methyl-containing alkylammonium nitrates in xylene. (auth)

25242 GAMMA SPECTROSCOPIC METHOD FOR PURSUING Zr–Hf SEPARATIONS. Blasius, E.; Neumann, W.; Wilkens, R. (Univ. des Saarlandes, Saarbrucken, Ger.). J. Radioanal. Chem.; 10: No. 1, 117-19(Feb 1972). (In German).

A quantitative γ-spectroscopic method for pursuing Zr–Hf separation is described. The nuclides ^{95}Zr and $^{175+181}Hf$ are used as tracer. Difficulties caused by the presence of the radioactive daughter ^{95}Nb are avoided by the application of a Ge(Li) detector. The simultaneous determination of Zr and Hf is possible over a wide range of concentration. (auth)

25243 DISTRIBUTION COEFFICIENTS FOR 65 ELEMENTS IN ACETIC ACID MEDIUM ON DOWEX 1X8. Van den Winkel, P.; de Corte, F.; Hoste, J. (Univ., Ghent). J. Radioanal. Chem.; 10: No. 1, 139-43(Feb 1972).

Adsorbabilities in acetic acid solutions from 4 to 17.4M on Dowex 1X8, 100 to 200 mesh are presented in tables. The elements are classified according to atomic number, Z. (M.C.G.)

25244 SYNTHESIS, ION-EXCHANGE BEHAVIOUR, AND ANALYTICAL APPLICATIONS OF STANNOUS FERROCYANIDE. SEPARATION OF Mg–Ca, Mg–Ba, Mn–Co, Mn–Ni, AND Y–Th. Qureshi, Mohsin; Varshney, K. G.; Khan, Fahmida (Aligarh Muslim Univ., India). J. Chromatogr.; 65: No. 3, 547-55(1 Mar 1972).

Stannous ferrocyanide was synthesized as an inorganic ion exchanger having an Sn : Fe ratio of I : I and a cation-exchange capacity of 2.03 mequiv/g (dry-weight). It is fairly stable in water and dilute solutions of acids, sodium and ammonium salts, and reducing agents such as hydrazine sulfate, ascorbic acid, and tartaric acid. Ion distribution studies of 28 metals were made on this ion exchanger, and on the basis of these studies five binary separations (Mg–Ba, Mg–Ca, Mn–Co, Mn–Ni and Y–Th) were achieved on its column. Papers impregnated with stannous ferrocyanide were also used for 18 other separations. A tentative structure of this compound is proposed on the basis of chemical analysis pH titrations, thermogravimetry, ir spectrophotometry, and the aqueous chemistry of tin and the ferrocyanide ion. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 25349, 25999, and 26000.

25245 ABSTRACTS OF PAPERS. 163rd National Meeting of the American Chemical Society, Boston, Massachusetts, April 9–14, 1972. Washington, D. C.; American Chemical Society (1972). 403p. $6.00. (CONF-720402-(Absts.)).

Chemical and Physical-Chemical Properties

Refer also to abstracts 25336, 25352, 25359, 25360, 26031, 26059, 27038, 27398, and 27410.

25246 (BNWL–1644) COLUMN CATION-EXCHANGE-CAPACITY PROCEDURE FOR LOW EXCHANGE CAPACITY SANDS. Routson, R. C.; Wildung, R. E.; Serne, R. J. (Battelle Pacific Northwest Labs., Richland, Wash.). Feb 1972. Contract AT(45-1)-1830. 16p. Dep. NTIS.

A rapid and sensitive cation-exchange-capacity (CEC) column procedure is described. This procedure is particularly useful for measuring the CEC of calcareous low-exchange-capacity sands and sandy soils. Entrained salt is removed by washing with an aqueous polyelectrolyte solution, but hydrolysis errors are minimized by limiting the amount of washing solution. A simple technique is described for estimating the extent of washing required. The procedure eliminates the replacement of the index cation, is amenable to the rapid measurement of CEC on large numbers of samples and is sufficiently precise for the measurement of the CEC of low-exchange capacity sands. (auth)

25247 (COO–1780–22) ONE AND TWO ELECTRON TRANSFER REACTIONS. Final Progress Report, March 1, 1971–February 28, 1972. Gordon, Gilbert (Iowa Univ., Iowa City. Dept. of Chemistry). 20 Feb 1972. Contract AT(11-1)-1780. 21p. Dep. NTIS.

25248 (UCRL–51137) THERMODYNAMICS OF THE GASEOUS HYDROXIDES. Jackson, Donald D. (California Univ., Livermore. Lawrence Livermore Lab.). 8 Dec 1971. Contract W-7405-eng-48. 141p. Dep. NTIS.

Both the bond energies and the free energies of formation of unknown gaseous mono- and dihydroxides were estimated. By using such experimental hydroxide bond energies as are available in the literature, a correlation scheme was developed for estimating the bond energies of unknown hydroxides by analogy with the bond energies of the corresponding mono- and dihalides, which are much better known. Estimated molecular constants were used to compute the thermodynamic functions of the unknown hydroxides between 298 and 3000°K. Then the thermodynamic functions were used to calculate the free energies of formation of the unknown hydroxides. Next, the free energies of formation were used to calculate the partial pressures of the unknown hydroxides in equilibrium with their condensed-oxide or -element phases. (These calculations were based on 1 atm each of oxygen and water and were done at intervals of 500°K between 500 and 2500°K.) The resulting volatilities are useful in predicting whether the unknown mono- and dihydroxides are likely to be important in reactions between the corresponding condensed oxides and water vapor. A tabulation of both the known and the estimated thermodynamic properties of the gaseous mono- and dihydroxides is included. (auth)

25249 STUDY ON THE CITRATE COMPLEXES OF MOLYBDENUM(VI) AND TUNGSTEN(VI) BY THE ION-EXCHANGE METHOD. Shishkov, D. A. (Mining and Geological Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 24: No. 6, 769–72(1971).

Photometric and ion-exchange quantitative studies on the molybdenum and tungsten complexes with citric acid are discussed. Relatively high stability of the complexes with five-term cycles was observed. (M.C.G.)

25250 CONDENSATION OF H_2 AND D_2: ASTROPHYSICS AND VACUUM TECHNOLOGY. Lee, T. J. (Culham Lab., Abingdon, Eng.). J. Vac. Sci. Technol.; 9: No. 1, 257–61(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

Measurements were made of the vapor pressure above layers of solid hydrogen and deuterium, grown either directly onto a copper substrate or onto previously condensed argon layers, at temperatures in the range 1.6 to 5.2°K. A number of vapor pressure curves were obtained for each layer with different heat fluxes incident on the hydrogen layers. Vapor pressures predicted by theory below 2.7°K could not be achieved. However, it is concluded that there is no real vapor pressure anomaly but that due to the difference in phonon spectra between the hydrogen layer and the copper substrate there exists a difference in temperature between them even under extremely low heat loads. The results of the experiments are discussed in relation to the design of hydrogen cryopumps, gage calibration, and the conditions required for the condensation of H_2 on solid grains in interstellar gas clouds. (auth)

25251 STOICHIOMETRY AND KINETICS OF THE THERMAL DECOMPOSITION OF MOLTEN ANHYDROUS LITHIUM NITRITE. Lee, A. K. K.; Johnson, E. F. (Princeton Univ., N. J.). Inorg. Chem.; 11: No. 4, 782–7(Apr 1972).

A semiflow batch reactor was used to study the thermal decomposition of molten anhydrous lithium nitrite at 250, 300, and 350°. The gaseous products of decomposition from a thin quiescent layer of molten nitrite were swept out of the reactor by a steady flow of argon gas. Kinetic curves of both the gas phase and the molten phase were obtained. The observed rate of overall nitrite decomposition can be represented by a first-order rate equation with the following rate constants: $k = (1.10 \pm 0.05) \times 10^{-6}$ sec^{-1} at 250°, $k = (1.30 \pm 0.07) \times 10^{-6}$ sec^{-1} at 300°, and $k = (1.25 \pm 0.07) \times 10^{-6}$ sec^{-1} at 350°. Individual reaction steps are proposed, which lead to the key reactions: $3LiNO_2 \rightleftharpoons LiNO_3 + Li_2O + 2NO$; $2LiNO_2 \rightleftharpoons Li_2O + N_2O + O_2$; $2LiNO_2 + 2NO \rightarrow 2LiNO_3 + N_2$; and, $2LiNO_3 \rightleftharpoons 2LiNO_3 + O_2$. The observed overall stoichiometries of decomposition are consistent with combinations of these reactions. Fused $LiNO_2$ has been considered to be a promising breeder blanket material in a deuterium–tritium-fueled thermonuclear reactor. (auth)

25252 POTENTIOMETRIC STUDY OF POLYMERIC ANIONS OF MOLYBDENUM IN NITRATE MELTS. Schlegel, James M.; Bauer, Roger (Rutgers–The State Univ., Newark, N. J.). Inorg. Chem.; 11: No. 4, 909–11(Apr 1972).

MoO_3 was added to $NaNO_3$–KNO_3 eutectic melt at 330°C, and the reactions studied potentiometrically. Results indicated that $Mo_2O_7^{2-}$ is the polymeric anion in equilibrium with MoO_4^{2-}. A possible explanation for previously reported results stating the polymer to be $Mo_3O_{10}^{2-}$ is given. (J.G.B.)

25253 INFLUENCE OF POLYVALENT IONS ON INTERFACIAL IMPEDANCE. Barker, G. C.; Gardner, A. W. (Atomic Energy Research Establishment, Harwell, Eng.). Chem.-Ing.-Tech.; 44: No. 4, 211–16(Feb 1972).

Preferential adsorption of a polyvalent ion may give rise to a series resistive component in the interfacial impedance when the ion is a minor component of the system. Studies of the potential dependence of this component by modulation polarography suggest that the adsorption of polyvalent cations at a negatively charged mercury electrode is dependent on both the nature of the polyvalent cation and on the identity of the univalent cation when the concentration of the latter ion greatly exceeds that of the polyvalent ion. Results for chloride solutions indicate that polyvalent cations, including thorium, are less strongly adsorbed when the electrode is positively charged than simple theory would predict. (auth)

25254 EFFECT OF ALKALI HALIDES ON THE ULTRASONIC ABSORPTION IN D_2O AND H_2O. Kor, S. K.; Awasthi, O. N.; Rai, Gulshan; Deorani, S. C. (Allahabad Univ., India). Nuovo Cim.; 8B: No. 2, 358–66(11 Apr 1972).

Ultrasonic absorption was studied in D_2O and H_2O in the presence of alkali halides in the frequency range (30 + 100) MHz by means of the pulse technique at 25°C. The effect of salts on the viscous and the structural absorptions of both the solvents is explained in terms of ion–solvent interactions. (auth)

25255 ULTRASONIC STUDY IN BINARY MIXTURES OF WATER AND HEAVY WATER. Kor, S. K.; Singh, B. K.; Deorani, S. C. (Allahabad Univ., India). Nuovo Cim.; 8B: No. 2, 367–72(11 Apr 1972).

An experimental study of ultrasonic absorption in water and heavy water mixtures was made at three concentrations from 10 to 50°C. Because of the close similarities in the behavior of these components, an ideal mixing was assumed. To explain the excess absorption, Hall's two-state model of structural absorption was used. The results are as expected, and the experimentally observed excess and the theoretically calculated structural absorption are in close agreement with each other in the present temperature range. The values $\Delta V/V = 0.47$ and $\beta_\infty = 17 \times 10^{-12}$ cm^2/dyne were assumed for computations. (auth)

Isotope Effects

Refer also to abstracts 25292 and 26434.

25256 MICROWAVE SPECTRUM OF DIMETHYL SULFONE. Saito, Shuji; Makino, Fumio (Sagami Chemical Research Center, Sagamihara, Japan). Bull. Chem. Soc. Jap.; 45: No. 1, 92–4 (Jan 1972).

The microwave spectra of normal and ^{13}C-labeled dimethyl sulfone were investigated, and the rotational constants of both species were determined. The following r_0-structural parameters were determined: $r(C-S) = 1.777 \pm 0.006$ Å, $r(S-O) = 1.431 \pm 0.004$ Å, $\angle CSC = 103°17' \pm 10'$, and $\angle OSO = 121°1' \pm 15'$, assuming that $r(C-H) = 1.091$ Å and $\angle HCH = 109°34'$. The variations in the structural parameters among the related alkyl sulfides, alkyl sulfoxides, and alkyl sulfones are discussed. The dipole moment was determined to be $\mu = 4.432 \pm 0.041$ D along the b axis. This value is consistent with the results of a bond-moment calculation based on the dipole moment of dimethyl sulfoxide. (auth)

25257 EXCHANGE REACTION OF DEUTERIUM WITH THE HYDROXYL GROUPS OF ZEOLITE CATALYSTS. Imanaka, Toshinobu; Okamoto, Yasuaki; Takahata, Kazunori; Teranishi, Shiichiro (Osaka Univ.). Bull. Chem. Soc. Jap.; 45: No. 2, 366-70(Feb 1972).

In order to estimate the reactivity of each hydroxyl group, the exchange reaction of deuterium with the hydroxyl groups on the surfaces of the HX, HY, and CaHX zeolites and aerosil was investigated kinetically by an infrared method. The hydroxyl groups appearing at 3660 cm^{-1} on the HX and HY zeolites were more readily exchanged with deuterium than were the other hydroxyl groups on the two zeolites. However, in the case of the CaHX, the order of activities of each hydroxyl group changed with the pressure of deuterium. The rate equation for the reaction is expressed by a Langmuir-type equation. This fact indicates the homogeneity of each hydroxyl group on zeolite. It was found that adsorbed water and carbon dioxide catalyzed the exchange reaction. Furthermore, a compensation effect between the apparent activation energies and the frequency factors occurs in this reaction. (auth)

25258 BEBO CALCULATIONS. I. ACTIVATION ENERGIES AND KINETIC ISOTOPE EFFECTS FOR THE REACTIONS OF CH_3 AND CF_3 RADICALS WITH HCl AND H_2S. Arthur, N. L.; McDonell, J. A. (La Trobe Univ., Bundoora, Australia). J. Chem. Phys.; 56: No. 6, 3100-10(15 Mar 1972).

The BEBO method was used to calculate activation energies, tunneling corrections, and kinetic isotope effects for the reactions of CH_3 and CF_3 radicals with HCl and H_2S on the basis of a three-atom model for the activated complex. For comparison with previous work, calculations were also made for the reactions of CH_3 and CF_3 with H_2 and SiH_4. The theoretical values are compared with the corresponding experimental results, and the role of tunneling, the variation of input data, and the effect of the polarity of the substrate are discussed. (auth)

25259 CONCERNING THE ISOTOPE EFFECT IN THE DECOMPOSITION OF AMMONIA ON TUNGSTEN SURFACES. Sheets, R.; Blyholder, G. (Univ. of Arkansas, Fayetteville). J. Phys. Chem.; 76: No. 7, 970-1(30 Mar 1972).

It has been stated in the literature that NH_3 decomposition on W being 1.6 times faster than ND_3 precludes N_2 desorption being the rate-determining step as has been suggested from kinetic measurements. Since ND_3 is a better electron donor than NH_3 a simple molecular orbital model of bonding to the surface is presented which suggests the isotope effect can be explained as a β-secondary isotope effect which is compatible with N_2 desorption being rate limiting. (auth)

25260 ISOTOPE EFFECTS IN PROTON-TRANSFER REACTIONS. II. A NOTE ON THE INFINITELY UNSYMMETRIC TRANSITION STATE. Melander, Lars (Univ. of Goteborg. Chalmers Inst. of Tech., Goteborg). Acta Chem. Scand.; 25: No. 10, 3821-6 1(1971).

An extremely exothermic hydrogen-transfer reaction could be expected to have a very reactant-like transition state and for isotopic hydrogen a specific-rate ratio approaching the square root of the inverse ratio between the reduced masses of the reactants. An extremely endothermic hydrogen transfer reaction could be expected to have a very product-like transition state and for isotopic hydrogen a specific-rate ratio approaching the square root of the inverse ratio between the reduced masses of the products multiplied by the ratio of the equilibrium constants of the corresponding isotopic reaction equilibria. The latter case could afford inverse primary kinetic hydrogen isotope effects. Such effects might have been observed. (auth)

25261 SELF-DIFFUSION AND ISOTOPE EFFECTS IN SILVER SINGLE CRYSTALS. Reimers, P.; Bartdorff, D. (Bundesanstalt fuer Materialpruefung, Berlin). Phys. Status Solidi (b); 50: No. 1, 305-10(1 Mar 1972). (In German).

The simultaneous diffusion of ^{105}Ag and ^{110}Ag in silver single crystals was measured between 673 and 954°C. The diffusion coefficients D_{110} are in good agreement with those recently published by Rothman et al. The magnitude of the isotope effect E decreases from 0.72 at 673°C to 0.58 ad 954°C. These values are also compatible with those measured by Rothman et al. The temperature dependence of both D and E may be explained by diffusion via single- and divacancies, according to Mehrer and Seeger (Phys. Status Solidi 39: 647(1970)). (auth)

25262 FLUORESCENCE AND TRIPLET YIELDS OF BENZENE AND TOLUENE IN CYCLOHEXANE SOLUTIONS. TEMPERATURE AND DEUTERATION EFFECTS. Sandros, Kjell (Chalmers Tekniska Hoegskola, Gotborg). Acta Chem. Scand.; 25: No. 10, 3651-5(1971).

Relative fluorescence yields of benzene, benzene-d_6, and toluene in dilute cyclohexane solutions were measured in the temperature range 7 to 50°C. Triplet yields of these compounds at 20°C were obtained from measurements of sensitized biacetyl luminescence. The triplet yield of benzene was also determined at 7°C. The results are compatible with a reaction scheme involving, inter alia, a thermally activated nonradiative process from the fluorescent state with the following activation energies: 0.288 eV (benzene), 0.292 eV (benzene-d_6), and 0.318 eV (toluene), together with a temperature-independent intersystem crossing process. A small, but significant, deuteration effect on the rate of the last process was observed. (auth)

25263 REACTIONS OF SULFUR ATOMS. XIII. EXPERIMENTAL AND CALCULATED SECONDARY HYDROGEN–DEUTERIUM KINETIC ISOTOPE EFFECT FOR THE $S(^3P)$ + ETHYLENE REACTION. Strausz, O. P.; Safarik, I.; O'Callaghan, W. B.; Gunning, H. E. (Univ. of Alberta, Edmonton). J. Amer. Chem. Soc.; 94: No. 6, 1828-34(22 Mar 1972).

An experimental and theoretical study was made of the secondary H/D kinetic isotope effect in the addition of $S(^3P)$ atoms to ethylene. The values of the experimental k_D/k_H ratios were 1.14, 1.07, and 1.04 for the $C_2D_4-C_2H_4$, $CD_2CH_4-C_2H_4$, and cis-$CHDCHD-C_2H_4$ reactant pairs, respectively. Calculation of the isotope effect was carried out within the framework of transition-state theory for two basic models of the transition state, a symmetrical ring and an asymmetrical ring-distorted structure. Either model can be made compatible with the experimental results by an appropriate and reasonable choice for the structural parameters of the transition state. Calculation of the isotope effect arising from each normal vibrational mode clearly shows that, contrary to current notions, the most important single factor inducing a secondary H/D isotope effect in addition reactions involving olefinic double bonds is not the out-of-plane bending motions of the CH bonds, but the gain in the isotopically sensitive vibrational degrees of freedom on going from reactant to activated complex. (auth)

25264 INTERNALLY COMPETITIVE CH_3 VS. CD_3 MIGRATION AND KINETIC ISOTOPE EFFECTS. A MEANS OF DETERMINING WHETHER OR NOT METHYL MIGRATION OCCURS IN THE RATE-CONTROLLING STEP. Schubert, W. M.; Lefevre, Paul H. (Univ. of Washington, Seattle). J. Amer. Chem. Soc.; 94: No. 5, 1639-45 (8 Mar 1972).

A test was made of the practical feasibility of a comparison between internally competitive CH_3-CD_3 migration and kinetic deuterium isotope effects as a relatively direct means of ascertaining whether or not the rate-controlling step of overall reaction and the migration step are one and the same. The test system is the rearrangement of $Ph_2COHCOH(CH_3)_2$ (I) and its mono-CD_3 (II) and di-CD_3 (III) derivatives in acidic media. A significant preference for CH_3 relative to CD_3 migration, 1.232, in the rearrangement of II was found by mass spectral analyses of product mixtures. Kinetic isotope effects were $k_I/k_{III} = 1.18$ and $k_I/k_{II} = 1.07$. A correlation between the kinetic isotope effects and the extent of CH_3-CD_3 migration was found, indicating coincidence of rate-controlling and migration steps for this system. Fast exchange of ^{18}O at the benzhydryl carbon indicates that methyl migration follows after a reversible C–O heterolysis step. Phenyl migration occurred as a side reaction to the extent of 10 to 14%, dependent on the medium, and had a somewhat greater isotope effect than methyl migration. (auth)

25265 ARRHENIUS PREEXPONENTIAL FACTORS FOR PRIMARY HYDROGEN KINETIC ISOTOPE EFFECTS. Schneider, Mary E.; Stern, Marvin J. (Yeshiva Univ., New York). Contract AT(30-1)-3663. J. Amer. Chem. Soc.; 94: No. 5, 1517-22(8 Mar 1972).

"Exact" model-reaction calculations were used to determine the lower limit to the Arrhenius preexponential factors, A_Q, for primary deuterium kinetic isotope effects in the harmonic approximation and in the absence of quantum mechanical tunneling. Attempts were made to force the A_Q values as low as possible solely through adjustments in the force constant changes, at the isotopic positions, between reactants and transition states. Values of A_Q lower than ~0.7 could not be achieved without making the models so mechanistically unreasonable as to render the results meaningless. A more conservative estimate of the lower limit, viz., $A_Q \gtrsim 0.5$, was obtained by considering the lowest value found for the Arrhenius preexponential factor of the purely quantum mechanical contribution to a kinetic isotope effect to be the lower limit to the preexponential factor of the entire isotope effect. This conclusion was in excellent agreement with a prediction made by Bell on the basis of a less rigorous theoretical treatment and lends support to the common practice of interpreting experimental values of A_Q significantly lower than 0.5 as due to the operation of tunneling in the reactions. (auth)

25266 PHOSPHORESCENCE LIFETIMES OF PARTIALLY DEUTERATED KETONES. Miller, John C.; Borkman, Raymond F. (Georgia Inst. of Tech., Atlanta). J. Chem. Phys.; 56: No. 7, 3727-9(1 Apr 1972).

The way in which the phosphorescence lifetime depends on the number of deuterium substituents and the effects of deuterium substitution at various chemically inequivalent sites within an unsymmetrical molecule were studied. (M.C.G.)

25267 RAMAN AND INFRARED SPECTRA OF LiO_2 IN OXYGEN MATRICES. Hatzenbuhler, Douglas A.; Andrews, Lester (Univ. of Virginia, Charlottesville). J. Chem. Phys.; 56: No. 7, 3398-3403(1 Apr 1972).

The Raman spectrum of the LiO_2 molecule was observed from samples of oxygen codeposited with lithium atoms at 15°K. An intense band at 1093 cm^{-1} in the Raman spectrum exhibited appropriate oxygen isotopic shifts for assignment to the symmetric oxygen-oxygen vibrational mode. Experiments using a $^{16}O_2$, $^{16}O^{18}O$, $^{18}O_2$ sample produced a triplet indicating equivalent oxygen atoms in the LiO_2 molecule. Lithium oxygen vibrations, which were very intense bands in the infrared spectrum, were not detected in the Raman spectrum. The observed Raman intensities strongly support the ionic model for LiO_2 proposed earlier. The experimental apparatus and techniques for laser-Raman matrix-isolation spectroscopy are described. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstracts 25342 and 25712.

25268 (AD-734383) CONCENTRATION OF BROMIDE IONS IN SEAWATER BY ISOTOPIC EXCHANGE. Foti, Stephen C. (Naval Ordnance Lab., White Oak, Md.). 8 Nov 1971. 16p. (NOLTR-71-216). NTIS.

The feasibility of concentrating radioactive bromide ions in seawater by passing the seawater through a column of silver bromide was studied. The radioactive bromide ions in the seawater are isotopically exchanged with the bromide ions in the silver bromide. The effect of column height, flow-rate, volume and/or residence time of seawater on the amount of bromine exchange was studied and each of these variables was found to have a significant effect. (auth) (NTIS)

25269 DISTRIBUTION OF HEAVY WATER IN THE CONJUGATED PHASE OF THE TRIETHYLAMINE-WATER SYSTEM. Hoffmann-Buechler, Margret (Technische Hochschule, Darmstadt, Ger.). Radiochim. Acta; 16: No. 2, 110-12(Nov 1971). (In German).

With a new method, the separation effect between light and heavy water was studied. Mixtures of triethylamine and water were allowed to stand until two clear phases appeared. Then, initial mixture conditions were restored by adding triethylamine to the heavy phase and by removal of triethylamine from the light phase. This process was repeated approximately ten times. During each of the adjustments, the H/D was determined by mass spectrometer. For water with an initial deuterium content of 147 ppM and a temperature of 20°C, the separation factor was $(0.762 \pm 0.031) \times 10^{-2}$; for 1052 ppM and 22.5°C, the corresponding value was $(0.796 \pm 0.076) \times 10^{-2}$. (H.B.G.)

25270 PROCESS FOR SEPARATING SPECIFIC RADIOELEMENTS, SINGLY OR MULTIPLY, FROM A MIXTURE OF RADIOACTIVE ELEMENTS. Maletskos, Constantine J.; Tang, Chung-wai (to United States Atomic Energy Commission). U. S. Patent 3,629,132. 21 Dec 1971. Filed 13 Feb 1969.

A process for removing radioisotopes of Na, K, and/or Cl from acidic aqueous solutions containing up to 40 vol % of an inorganic acid comprises dispersing ~1 part of the acidic solution in ~9 parts of a water-miscible organic elutant having a boiling point of <100°C and passing the elutant containing the radioactive Na, K, or Cl over a column of solid nonradioactive inorganic salt of the radioactive element to be separated. (B.L.M.)

25271 EXAMINATION OF THE EXCHANGE OF DEUTERIUM FROM DEUTERIUM OXIDE IN CARBON TETRACHLORIDE SOLUTION WITH HYDROGEN IN GLASS USING INFRARED SPECTROMETRY. Glascoe, Paul K.; Bush, Charles N. (Wittenberg Univ., Springfield, Ohio). Anal. Chem.; 44: No. 4, 833-4(Apr 1972).

Some ground glass was introduced into a cell containing a D_2O-CCl_4 solution and the rate of formation of HOD was measured. A large part of the exchange occurred relatively rapidly and this was followed by a slow exchange over a long period of time. The greater adsorption of deuterium compared to hydrogen on the glass surfaces suggests a possible explanation for the deuterium effect shown by glass electrodes. (M.C.G.)

25272 CRITICAL EXAMINATION OF THE ASSUMPTIONS INHERENT IN THE TREATMENT OF EXPERIMENTAL DATA FROM DISSOCIATIVE BASE-CATALYZED H-D EXCHANGE. Sachs, William H. (Univ. of Umea, Sweden). Acta Chem. Scand.; 25: No. 3, 3123-4(1971).

The assumptions inherent in the equations used to treat experimental data from studies of dissociative base-catalyzed H-D exchange are examined in detail. Observed rate constants evaluated from the slopes of log-time plots of primary data depend on the magnitudes of isotope effects and initial concentrations in a manner that may lead to discrepancies between independent studies. Obvious sources of curvature in such plots, including secondary isotope effects, are treated quantitatively. (auth)

25273 DEVELOPMENT OF A NEW METHOD FOR INVESTIGATION OF ISOTOPE EXCHANGE INTERMEDIATE PROCESSES BASED ON OVERLAPPING OF DIFFUSION AND EXCHANGE (MATHEMATICAL SIMULATION ON AN ANALOG CALCULATOR). Heckner, K.-H.; Ruhtenberg, W.-D. (Humboldt-Univ., Berlin). Isotopenpraxis; 7: No. 9, 384-90(Sep 1971). (In German).

A new method for the investigation of homogeneous isotopic exchange reactions in liquid phases, which requires no chemical analytical separation of the reactants, is described. The method is based on the superposition of diffusion on exchange kinetics under conditions where the two processes proceed with comparable rates. Application of the principle of pulsation diffusion (significant acceleration of diffusion transport) renders accessible rate constants in the range from approximately 10^{-3} mole l^{-1} sec^{-1} to 50 mole l^{-1} sec^{-1}. Optimization of conditions for the method is obtained through mathematical simulation in an analog computer. Applicability of the method requires sufficiently distinct diffusion coefficients for the two exchange partners. (tr-auth)

25274 ELECTROMIGRATION OF HYDROGEN ISOTOPES IN V, Nb, AND Ta. Herold, A.; Mareche, J. F.; Rat, J. C. (Univ., Nancy). Compt. Rend., Ser. C; 273: No. 25, 1736-9(20 Dec 1971). (In French).

Hydrogen and deuterium contained in group V transition elements in the form of α solid solutions migrate in the same direction as the current. At 600°C the flow rates are proportional to the current; proportionality with respect to $\sqrt{P}$ (P = pressure) is not always observed. The flow rates relative to the isotopes having masses of 1 and 2 are in the ratio $\sqrt{2}$. (France)

25275 TEMPERATURE DEPENDENCE OF THE FRACTIONATION OF TRITIATED WATER IN AN EQUILIBRIUM BETWEEN CRYSTALLINE ALUM AND ITS AQUEOUS SOLUTION. Tanaka, Haruhiko (Hiroshima Univ.). Bull. Chem. Soc. Jap.; 45: No. 2, 339-43(Feb 1972).

The temperature dependence of the fractionation of tritiated water (HTO) was examined during the crystal growth of alum from its tritiated aqueous solution. When the ratios of the mole fractions of HTO in the water of crystallization to that of the mother liquid, S, at various temperatures are compared, the following order is established: $S_{19.90} \approx S_{29.50} > S_{36.52} > S_{41.95} > S_{47.43} > S_{53.70} \approx S_{69.50}$, where the subscripts represent the crystallization temperatures, and where $S_{19.90} = 0.975$ and $S_{69.50} = 0.949$. The concept of the hydration of ions developed recently was applied to the problem of the crystal growth from the solution. Two kinetic parameters, such as the relaxation time of the aluminum ion for entering the surface, τ_c, and that of the hydrated aluminum ion, $Al(OH_2)_6^{3+}$, for the exchange of the water with bulk water, τ_e, were taken into account to explain the fractionation. A surface-diffusion mechanism was suggested as essential in the crystal growth of alum from the solution. The activation free energy for the crystal growth from an unstirred solution was found to be 18.17 kcal/mole, a value which was in good agreement with the value given by Bennema. (auth)

25276 MECHANISM OF THE ISOTOPIC EXCHANGE OF THE C-8 HYDROGEN OF PURINES IN NUCLEOSIDES AND IN DEOXYRIBONUCLEIC ACID. Tomasz, Maria; Olson, Janet; Mercado, Carmen M. (Hunter Coll., New York). Biochemistry; 11: No. 7, 1235-41(28 Mar 1972).

The kinetics of exchange of tritium in the C-8 position of guanosine, 1-methylguanosine, adenosine, and guanine residues of DNA were determined at various pH values at 37°C. At constant pH pseudo-first-order kinetics were observed in all cases. The rate of the exchange reaction was completely independent of pH in the wide pH ranges employed with the exception of guanosine, which showed a rate increase in the pH range of about 7 to 11, similar in shape to the titration curve of the N-1-H group of guanosine. Catalysis by buffer anions was not observed in the compounds tested (guanosine and adenosine). The pH-independent kinetics are best interpreted by postulating that the mechanism of the exchange reaction consists of the OH^--catalyzed abstrac-

tion of the C-8 hydrogen ion from the 7-protonated form of the purines giving rise to an ylid-type intermediate, which is then reprotonated at C-8 by the medium. This type of mechanism was typically observed in imidazoles and other related 5-membered heterocyclic systems by other investigators. The "anomalous" rate boost by alkali in the case of guanosine is explained by the following scheme: in addition to the main pH-independent mechanism a second pathway of exchange exists involving the participation of a new tautomeric form of guanosine: the guanosine zwitterion. Its tautomeric equilibrium constant, calculated from pK_a data, is 1.9×10^{-5} at 37°C and at 0.1 ionic strength. It is proposed that this form may be considered as a "rare tautomer" capable of mispairing in the course of DNA replication. (auth)

25277 SELF-DIFFUSION IN Tl(I)–Tl(III) ISOTOPE EXCHANGE. Gosman, A. (Technical Univ., Prague). Radiochem. Radioanal. Lett.; 9: No. 5-6, 357-61(31 Mar 1972).

The role of diffusion in the Tl(I)–Tl(III) exchange in $HClO_4$ solutions, and the dependence of the rate constants on pH and on the self-diffusion coefficients of thallium were studied. (auth)

25278 ACID CATALYSED TRITIUM EXCHANGE REACTIONS AS A METHOD FOR THE PRODUCTION OF LABELED ORGANIC COMPOUNDS. Bursics, L.; Tanacs, B.; Marton, J. (Inst. of Isotopes, Budapest). Radioisotopy; 12: No. 4, 575-87(1971).

Developments of isotopic exchange reactions of hydrogen in the past 5 to 10 years are reviewed and discussed. An attempt is made to discuss mechanistic as well as practical (synthetic) aspects of acid catalysis of hydrogen exchange. Scope and limitations of the method from the manufacturer's point of view are emphasized. (auth)

25279 ROLE OF HETEROGEN CATALYTIC EXCHANGE REACTION BETWEEN TRITIUM GAS AND THE,SOLVENT IN THE CATALYTIC TRITIATION OF UNSATURATED COMPOUNDS. Marton, J.; Kovacs, A. (Inst. of Isotopes, Budapest). Radioisotopy; 12: No. 4, 595-604(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

Catalytic tritiations of unsaturated compounds showed that the specific activity of products formed were generally lower than that of the starting tritium gas. This was attributed to a rapid catalytic exchange reaction between the solvents and the tritium gas, although these reactions were not investigated in detail. There is a close correlation among the specific activity of the products formed, the tritium incorporation into the solvent, and the rate of hydrogen (tritium) consumption. Experiments, carried out in different solvents with carrier-free tritium gas, as well as in tritiated solvents by using natural hydrogen, led to the conclusion that there should exist a direct hydrogen transfer reaction between the solvent and the unsaturated substrate. Some mechanistic aspects of catalytic hydrogenation are also discussed. (auth)

25280 INTERACTION BETWEEN TRITIUM GAS AND SOLVENTS UNDER CONDITIONS OF CATALYTIC HYDROGENATION. Cerny, B.; Hanus, J. (Inst. for Biological Research, Prague). Radioisotopy; 12: No. 4, 605-25(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

The dependence on time of the exchange of tritium into dioxane, tetrahydrofuran, ethyl acetate, and pentafluoropropionic acid anhydride in the presence of Pt, Pd (ADAMS), and $Pd/BaSO_4$ was investigated. The effect of the Wilzbach reaction on these solvents was also studied. Its share in the tritium exchange was very low. For the solvents and catalysts investigated the following dependencies were observed: after 2 to 3 hours the exchange attained limiting values (These values are not directly proportional to the pressure and the specific activity of the tritium used.); exchanges into the solvents were caused mainly by impurities present; platinum (ADAMS) caused higher exchange than Pd catalysts; and exchanges into dioxane (or more correctly into impurities present in it) were strongly suppressed by the presence of the CC unsaturated compound, which is hydrogenated. (auth)

25281 APPROXIMATE ESTIMATION OF THE RATE OF ISOTOPIC EXCHANGE REACTION BETWEEN INORGANIC IODIDE AND SUBSTITUTED ARYL IODIDES, BASED ON THE HMO THEORY. Spevacek, V. (Inst. of Nuclear Research, Rez, Czech.). Radioisotopy; 12: No. 5, 699-705(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

One group of iodine compounds used in nuclear medicine contains derivatives of an aryl iodide labeled with radioactive iodine-131 or 125. Either the rates of isotopic exchange reactions of iodine in these compounds differ up to ten orders of magnitude, or the reaction does not take place. To evaluate the convenience of preparation of a compound labeled with iodine by isotopic exchange it is useful to know, even approximately, the rate of the isotopic exchange reaction between the respective compound and iodine, and also the effect of structure on the rate. A procedure is shown to estimate the rate of isotopic exchange between substituted aryl iodides and inorganic iodide on the basis of localization energies (Δ W) calculated by Hückel theory of molecular orbits. A relation between the rate constant k ($1\ mol^{-1}$) at 195°C and the localization energy Δ W was found: $\log k \pm 1.0 = -22.7\ \Delta W + 80.0$. The effect of electrolyte dissociation in organic solvents on the rate is also discussed. (auth)

25282 ISOTOPIC EXCHANGE OF 2-THIOURACIL AND 2-THIO-6-AZAURACIL DERIVATIVES WITH ELEMENTARY SULFUR ^{35}S. Kolina, J. (Inst. for Research, Production, and Uses of Radioisotopes, Prague). Radioisotopy; 12: No 6, 989-96(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

The methyl derivatives of 2-thiouracil and 2-thio-6-azauracil show an inhibitory effect on the thyroid activity. To study their metabolism and distribution in an organism it is useful to have them radioactively labeled. The radionuclide ^{35}S was chosen as label and the isotopic exchange reaction between elementary sulfur ^{35}S and the nonactive thio compounds as the method of preparation. The exchange reactions were performed in pyridine. The method allows the preparation of labeled compounds in high yield, with a relatively high specific activity (50 to 100 mCi/mMole) and high radiochemical purity (>90%). Attention is paid namely to the influence of the structure of thiocompounds on the course of the isotopic exchange. (auth)

25283 ISOTOPIC EXCHANGE OF THIOUREA AND ITS DERIVATIVES WITH ^{35}S. Benes, J. (Inst. for Biological Research, Prague); Vulterin, K.; Kolina, J. Radioisotopy; 12: No. 6, 1029-38(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971)

^{35}S of high specific activity was used for the isotopic exchange and optimum conditions for the exchange process were studied. The influence of the solvent on the exchange process was investigated. It was advantageous if the reaction proceeded in an inert atmosphere or in vacuum. The exchange rate determination and analysis of the reaction mixture were performed by paper chromatography in a number of solvent systems, subsequent autoradiography, and scanning of paper chromatograms. The influence of the structure of thiourea derivatives on the isotopic exchange was evaluated from the viewpoint of existing theories of the isotopic exchange mechanisms. (auth)

Feed Materials Processing

Refer also to abstract 26046.

Radiation Chemistry

Refer also to abstracts 25245, 25343, 25345, 25346, 25375, 25377, 25378, 25398, 25723, 25729, 25730, 25740, 25743, 25777, 26125, 26130, 26132, 27274–27276, and 27298.

25284 (CNEA–302) FLUORESCENCE QUENCHING PROCESSES IN LUMINESCENT BORAZINE DERIVATIVES. Molinari, M. A.; Videla, G. J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1971. 11p. (In Spanish). Dep. NTIS (U. S. Sales Only).

The relation between intensity of fluorescence induced by gamma radiation and concentration in benzene solution of different borazine derivatives was studied. Correlation was made with the parameters of the Kallman equation which describes the phenomenon. A satisfactory agreement was found. (auth)

25285 (JAERI-M-4573) RADIOLYSES OF THE MIXTURES OF AMMONIA AND HYDROCARBONS. 2. FORMATION OF HYDROGEN FROM THE MIXTURES OF AMMONIA AND OLEFINS (ETHYLENE, PROPYLENE, AND BUTADIENE). Hamanoue, Kumao; Okamoto, Jiro; Tokunaga, Okihiro; Danno, Akibumi; Sato, Shoichi (Japan Atomic Energy Research Inst., Tokyo). Sep 1971. 14p. (In Japanese). NTIS (U. S. Sales Only).

The γ radiolyses of the gaseous mixtures of ammonia and olefins (ethylene, propylene, and butadiene) were investigated and the primary processes of hydrogen formation were considered. From the extrapolated values of $G(H_2)$, which were obtained in the γ radiolyses of the mixtures of ammonia and olefins, it was found that the $G(H_2)$ of ammonia, ethylene, propylene, and butadiene are 0.68 to 0.72, 1.26, 1.06, and 0.33, respectively. The gas-phase radiolyses of ammonia–perdeuterated olefins mixtures were also

investigated. Using the data for isotopic mixtures of hydrogen, kinetic calculations were made and the following results obtained: hydrogen molecules produced by the γ radiolysis of ammonia are thermal and nonscavengeable (the latter are produced for the most part through a unimolecular process) and almost all of hydrogen molecules produced by the γ radiolyses of olefins (ethylene, propylene, and butadiene) are nonscavengeable. In the case of ethylene a unimolecular process plays an important role, and in the others bimolecular processes are important. In the case of butadiene, $G(H_2)$ values are very small compared with those of other olefins and with that of calculated value of butadiene, i.e., $G(H_2) > 1$. These discrepancies can be explained if it is considered that the hot hydrogen radical may partly react with butadiene to form 2-butene. (auth) (Japan)

25286 ESR DETECTION OF INTERMEDIATE RADICAL SPECIES FORMED IN THE DECOMPOSITION OF SOME IRRADIATED NITRAMINES. Darnez, Charles; Paviot, Jacques (CEA, Le Barp, France). Int. J. Radiat. Phys. Chem.; 4: No. 1, 11-23(Feb 1972). (In French).

The effect of uv illumination on some secondary nitramines (RN_2-NO_2) was studied by ESR. In all cases described a radical intermediate species of a nitroxide type was proven. Its formation may be explained by production of a precursor corresponding to an intramolecular rearrangement of the nitramine group. The spectra are identical to those obtained previously using γ radiation. (auth)

25287 RADIOTHERMOLUMINESCENCE STUDIES OF SELF-ABSORPTION OF LIGHT EMITTED IN FROZEN SAMPLES. Zagorski, Z. P.; Zimek, Z.; Sitkowska, E. (Inst. of Nuclear Research, Warsaw). Int. J. Radiat. Phys. Chem.; 4: No. 1, 65-73(Feb 1972).

Frozen liquids prepared for low-temperature radiation chemistry are seldom glassy. Usually they are polycrystalline and therefore opaque. It is shown theoretically that the intensity of radiothermoluminescence measured as a function of the sample thickness may give information as to the extent of self-absorption and its relation to the structure of the frozen liquid. Several possible cases are discussed and that of a matrix with a low concentration of a dye is compared experimentally with theory. As a model the system of frozen benzene was chosen without and with different concentrations of 0-toluene azo-β-naphthol as a compound which absorbs emitted thermoluminescence light, measured by a photomultiplier with filters. Irradiations were made at 77°K in a ^{60}Co source with a dose of 160 ± 5 R. Owing to the high radiation yield of quanta, the low extent of radiolysis and the low concentration of the dye, the latter was just acting physically without disturbing the position of the thermoluminescence peaks. The light path factor was determined in this case to be 9 ± 1.5, which means that in the frozen benzene matrix the internally emitted light travels a path one order of magnitude longer as compared to a glassy sample of the same geometrical shape. (auth)

25288 RADIATION INDUCED PREPARATION OF LABELLED ORGANIC COMPOUNDS. III. INCORPORATION OF $^{14}CO_2$ AND OF $H^{14}COO^-$ INTO AMINES. Getoff, N. F. (Reaktorzentrum Seibersdorf, Vienna); Guetlbauer, F.; de la Paz, L. R. Kerntechnik; 14: No. 2, 75-81(Feb 1972). (In German and English).

The radioinduced carboxylation of several amines (methyl-, ethyl-, n-propyl- and γ-isoamylamines) in aqueous solutions was investigated under various experimental conditions. The carboxylating agents used were $^{14}CO_2$ and/or $H^{14}COO^-$ ($H^{14}COOH$). The G-values of the amino acids formed were determined. They are relatively low (0.1 to 1.3) and depend on the concentrations of the reacting partners and on the pH of the irradiated solutions. The carboxylation process is explained in terms of the probable reactions. (auth)

25289 FREE ION YIELDS IN γ-IRRADIATED MIXED SOLVENTS. Freeman, Gordon R. (Univ. of Alberta, Edmonton). J. Phys. Chem.; 76: No. 6, 944-5(16 Mar 1972).

The model developed to explain yields in pure liquids does not apply to free ion yields in ethanol–n-hexane mixtures recently measured by Brown, Barker, and Sangster J. Phys. Chem. 75, 3639 (1971). The values of the bulk dielectric constants reported are intermediate between the net values that would be obtained if the ethanol and n-hexane were in unmixed layers parallel to the electrodes and those that would be obtained if the compounds were in unmixed layers perpendicular to the plane parallel electrodes. The measured dielectric constants are a further indication that the alcohol forms clusters in the nonpolar hexane. It was concluded that the free ion yield for the mixture would be more appropriately interpreted in terms of a charge-scavenging process than in terms of the free ion yield model for pure liquids. (D.H.M.)

25290 RADIATION-INDUCED POLYMERIZATION OF PURE STYRENE AT LOW TEMPERATURE. Machi, Sueo (Univ. of Maryland, College Park); Silverman, Joseph; Metz, Donald J. J. Phys. Chem.; 76: No. 6, 930-7(16 Mar 1972).

The radiation-induced polymerization of styrene was carried out over a range of temperature from 0 to −78°C using superdry styrene and wet styrene. Molecular weight distributions were determined by gel permeation chromatography. In the course of the rate studies, the time of contact between styrene and silica gel was found to be an important factor. Partially dried liquid styrene shows a bimodal molecular weight distribution which reflects the simultaneous operation of ionic and radical processes. Upon solidification, superdry styrene exhibits a sharply decreased rate of polymerization, while wet styrene shows a marked increase. The polymer from superdry styrene shows a unimodal molecular weight distribution when formed in the liquid phase and a multimodal distribution when polymerized as a solid. At −78°C, the rate of polymerization and the molecular weight of the product are rather low. In a sample irradiated at −78°C and then stored at the freezing point of styrene (−30.5°C) for a few hours, the polymer yield shows a large increase accompanied by the appearance of a very high molecular weight fraction in the distribution curve. Traces of water have no effect on the rate of polymerization and molecular weight distribution of frozen samples. A high yield of dimer and trimer, $G \approx 2.5$, is observed in wet liquid styrene. This can be attributed either to intraspur radical reactions or to water terminated ionic reaction in the bulk phase. The results in the solid state polymerization fit the assumption that a carbonium ion propagation predominates regardless of the water content. (auth)

25291 PULSE RADIOLYSIS STUDY OF THE KINETICS OF FORMATION OF Na^- IN ETHYLENEDIAMINE BY THE REACTION OF SOLVATED ELECTRONS WITH SODIUM IONS. Dye, James L. (Michigan State Univ., East Lansing); DeBacker, Marc G.; Eyre, John A.; Dorfman, Leon M. J. Phys. Chem.; 76: No. 6, 839-46 (16 Mar 1972).

Fast reaction studies of the formation of Na^- in ethylenediamine from e^-_{sol} and sodium ion were carried out by the pulse radiolysis method. The decay of the absorbance of e^-_{sol} and the growth of that of Na^- were both second order with similar rate constants which were independent of the concentration of sodium ion above about 10^{-2} M but decreased with a decrease in the concentration of Na^+ below this value. The presence of Cs^+ had no effect upon the rate. At low concentrations of Na^+, excess K^+ caused the reaction to reach equilibrium rather than to proceed to completion. The results show that the formation of species containing two electrons (which may be coupled with metal cation) precedes the reaction in which Na^- is formed. Quantitative kinetic tests of the mechanism are presented. (auth)

25292 ISOTOPE EFFECTS IN AUTOXIDATION. II. OXIDATION OF $C_{11}H_{24}/C_{11}D_{24}$ AND POLYSTYRENE/POLYSTYRENE-[α,β-D_3] INITIATED BY THERMAL, PHOTOLYTIC OR RADIOLYTIC PROCESSES. Rummel, S.; Huebner, H. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Leipzig). Isotopenpraxis; 7: No. 11-12, 462-5(Nov-Dec 1971). (In German).

The isotope effect between hydrogen and deuterium was studied for the total reaction rate of oxidation in two model substances. Thermally induced oxidation proceeded in $C_{11}D_{24}$; in polystyrene, the corresponding effect amounted to a factor of 5.8. Photolytically and radiolytically induced oxidations were studied either with mercury ultraviolet or with ^{60}Co gamma radiation, respectively. Under these conditions, the isotope effects were considerably smaller than the thermal ones. For $C_{11}H_{24}/C_{11}D_{24}$ irradiated with 100 Mr at 0.35 Mr/hour, an isotope effect of 1.3 was obtained. (H.B.G.)

25293 APPLICATION OF ESR SPECTRA TO THE STUDY OF RADIOCHEMICAL GRAFTING OF STYRENE ONTO POLYOLEFINS. RESEARCH ON GROWING RADICALS OF GRAFTED POLYSTYRENE. Czvikovszki, T.; Marx, Rose (Paris Univ., Orsay, France). J. Chim. Phys.; 68: No. 11-12, 1660-9(Nov-Dec 1971). (In French).

The ESR spectra of polyolefins (polyethylene and polypropylene) irradiated (^{60}Co γ radiation) in the presence of styrene enabled the different radicals produced and their possible roles in radiochemical grafting to be determined. In the case of polypropylene, the nature of the radicals formed depends upon the crystalline state of the solid: alkyl radicals are produced below the vitreous transition temperature and allyl radicals are produced above this temperature. The spectra of the growing chain styrene radicals depend upon the state of progression of the grafting. This is shown from in situ EPR measurements made during γ irradiation in a reactor. The contribution of the two types of radicals observed to the grafting reaction is discussed in terms of the kinetic behavior observed in the experiment and the behavior observed by other workers. (France)

25294 RADICALS FORMED IN THE GASEOUS PHASE BY THE IMPACT OF LOW ENERGY ELECTRONS ON HYDROCARBONS. Marx, Rose; Mauclaire, G.; Wallart, M. (Pairs Univ., Orsay, France). J. Chim. Phys.; 68: No. 11-12, 1680-5(Nov-Dec 1971). (In French).

Radicals formed during the radiolysis of gaseous neopentane with slow electrons (5 to 100 eV) were studied by ESR. Two radicals were observed, the tert-butyl ($t-C_4H_9$) and the neopentyl (C_5H_{11}). Investigations of the radical concentration as a function of the electron energy facilitated the determination of the potentials at which the radicals appear and demonstrated that the radicals were formed at potentials less than the ionization potential of neopentane. Studies made as a function of the pressure enabled the overall order of the reactions forming the radicals to be determined. An attempt was made to use these results to determine the reactions leading to the formation of the radicals observed: decomposition of excited molecules and ion reactions. (France)

25295 CHANGE OF THE PROPERTIES OF COMPOUNDS FORMED ON THE BASIS OF PHENOL-FORMALDEHYDE RESIN UNDER IRRADIATION. Ambardanishvili, T. S.; Vdovenko, O. P.; Dundua, V. Yu.; Kolomiitsev, M. A.; Pachuliya, N. V. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 65: No. 3, 593-6(Mar 1972). (In Russian).

A study was made of the changes in water absorption and the quantity of acetone-extracted products from resol compounds with graphite and aluminum filling after γ-irradiation in the range of 1 to 1000 Mrad. Thermogravimetric analysis of the same compounds after irradiation by the integral flow of the neutrons $\sim 10^{18}$ n/cm^2 was carried out. (auth)

25296 PRELIMINARY OBSERVATIONS ON A NEW CLASS OF SENSITIZERS FOR CROSSLINKING POLYOLEFINS. Charlesby, A.; Fydelor, P. J. (Royal Military Coll. of Science, Shrivenham, Eng.). Int. J. Radiat. Phys. Chem.; 4: No. 1, 107-11(Feb 1972).

A number of hydrocarbon polymers, when irradiated with ionizing radiations in the presence of low concentrations of acrylic and methacrylic acid monomers, form crosslinked structures. The radiation doses and reacted concentrations of acrylic monomers required to achieve substantial gelation of the polymers are considerably less than would be predicted on the basis of a simple model for random crosslinking, either directly or via propagation of a graft-copolymer chain. Other vinyl monomers, many of which graft readily, do not show this sensitized form of crosslinking. Evidence is presented to show that the products of reaction represent a truly crosslinked system and that the reaction occurs via a nonrandom process with a very high G value for crosslinking, which can best be explained by a novel chain reaction for crosslinking as distinct from grafting. (auth)

25297 PROGRESS IN APPLICATION OF RADIOACTIVE RAY IN CHEMICAL INDUSTRY. 3. RADIATION SOURCES AND REACTION APPARATUSES. PART 2. Machi, Sueo; Kawakami, Waichiro (Japan Atomic Energy Research Inst., Takasaki). Sekiyu To Sekiyu Kagaku; 15: No. 6, 84-8(May 1971). (In Japanese).

The effects of stirring on radiation-chemical reactions under given distributions of dose rate and the effects of stirring on radiopolymerization under given dose rate distribution were surveyed. Stirring is more important in radiation chemistry than it is in ordinary chemical reactions because the lifetime of active species is usually much shorter than that of the original substances. With increased stirring, reaction rate increased. The rate of diffusion plays an important role in the rate of reaction because radical concentration increases with increasing rate of diffusion. Rate of polymerization and number averaged degree of polymerization increased with increasing stirring rate. Two peaks appeared in the distribution of the degree of polymerization when the rate of stirring was low. In the low-dose-rate region, the radical concentration was low, so polymers grew sufficiently and polymers of a high degree of polymerization resulted. (Japan)

25298 FORMATION AND DECAY OF RADICAL-IONS OF ACRIDINE AND EMISSION OF THERMOLUMINESCENCE IN IRRADIATED POLYMETHYLMETHACRYLATE. David, C.; Janssen, P.; Geuskens, G. (Univ. Libre, Brussels). Int. J. Radiat. Phys. Chem.; 4: No. 1, 51-63(Feb 1972).

Radiolysis of poly(methyl methacrylate) at 77°K in the presence of acridine results in the formation of anions and cations of the additive. Their concentration first increases with acridine content and then reaches a limit which indicates that the migration distance is larger for negative than for positive charges. Formation of the cation is inhibited by methyltetrahydrofuran (MTHF). The anion can be photo-bleached by visible light and does not appear when the polymer contains CCl_4. Anions and cations of acridine decay by steps at successive constant temperatures between 150°K and 300°K, while a new radical is formed by addition to the anion of a proton from the polymer matrix. On warming the sample at a rate of 5° min^{-1} a glow curve with a maximum at 160°K is observed. This emission corresponds to the fluorescence of acridine. If the temperature is increased stepwise, the intensity of fluorescence decays stepwise at temperatures lower than those at which most of the ions disappear, and proceeds with a much lower yield if the sample contains CCl_4 or MTHF. Thermoluminescence is assigned to the recombination of close acridine ion pairs. (auth)

25299 CONCERNING THE STATE OF Fe(III) IN SULPHURIC SOLUTIONS. Broszkiewicz, R. K. (Inst. of Nuclear Research, Warsaw). Int. J. Radiat. Phys Chem.; 4: No. 1, 119-20(Feb 1972).

The radiochemical results of Czapski and Meisel (Int. J. Radiat. Phys. Chem: 3: 11 (1971)) are discussed in view of the structure and concentration of the Fe(III) complexes in sulphuric solution at various acid pH's. (auth)

25300 REDUCTION OF Fe(III) BY ORGANIC FREE RADICALS. Broszkiewicz, R. K. (Inst. of Nuclear Research, Warsaw) Int. J. Radiat. Phys. Chem ; 4: No. 1, 117-18(Feb 1972).

The results of Bhattacharyya and Kundu (Int. J. Radiat. Phys. Chem. 3: 1 (1971)) on the radiolysis of the aqueous Fe(III)–EDTA system are discussed in view of previous results of the present author. (auth)

25301 DESIGN CONSIDERATIONS FOR NANOSECOND PULSE RADIOLYSIS STUDIES USING KINETIC SPECTROPHOTOMETRY. Hunt, J. W.; Greenstock, C. L.; Bronskill, M. J. (Univ. of Toronto). Int. J. Radiat. Phys. Chem.; 4: No. 1, 87-105(Feb 1972).

A detailed study of the design parameters for nanosecond pulse radiolysis using a 40-MeV linear accelerator is presented. The factors involved in optimizing an optical system consisting of a high-intensity light source, multi-pass detection cell, and monochromator are considered in detail and a practical design is given. All aspects of the electronic detection system are discussed and practical circuits for 1P28-type photomultiplier tubes are shown to be linear within ±10% to over 6 mA output current. A unique triggering system is described, which permits the display of complete pulse radiolysis information (light intensity and zero signal levels as well as transient signals) on a single photograph. (auth)

25302 NOVEL RADIOLYTIC SPECIES IN AQUEOUS POTASSIUM BROMIDE SOLUTIONS AS STUDIED BY PULSE RADIOLYSIS. Cercek, B. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Phys. Chem.; 4: No. 1, 25-30(Feb 1972).

The tribromide ion-radical, Br_3^{2-}, and its protonated form HBr_3^- were observed in the pulse radiolysis of 0.3 mol dm^{-3} aqueous KBr solutions. Br_3^{2-} and HBr_3^- have optical absorption maxima at 270 and 360 nm. The molar extinction coefficients of Br_3^{2-} and HBr_3^- are 224 and 445 m^2/mol at 270 nm, and at 360 nm 1020 and 840 m^2/mol respectively. These species are in equilibrium with dibromide ion-radicals, i.e., $Br_3^{2-} \rightleftharpoons Br_2^- + Br^-$, pK = 1.3, $HBr_3^- \rightleftharpoons Br_2^- + H^+ + Br^-$, pK = 1.0, and $HBr_3^- \rightleftharpoons Br_3^{2-} + H^+$, pK = 3.7. (auth)

25303 RADIOLYTIC DESTRUCTION OF NONBIODEGRADABLE ORGANIC PESTICIDES. Case, Forrest N.; Garrison, Arthur W.; Kau, Donald L.; Smiley, David E. (to United States Atomic Energy Commission). U. S. Patent 3,640,808. 8 Feb 1972. Filed 7 Oct 1969.

A method for treating industrial waste solutions containing nonbiodegradable organic pesticides is described that comprises saturating the solution with oxygen and then irradiating the pressurized solution until the pesticide is decomposed into nontoxic constituents to the degree required for safe disposal. (auth)

25304 PROCESS FOR PREPARING VINYL CHLORIDE POLYMERS OR COPOLYMERS HAVING BUTADIENE AND ACRYLATE MONOMERS RADIATION GRAFTED THERETO. Sagane, Norio; Harayama, Hiroshi; Morishima, Yotaro (to Sekisui Kagaku Kogyo Kabushiki Kaisha). U. S. Patent 3,645,870. 29 Feb 1972. Priority date 20 Jul 1968, Japan.

A process is described for producing high-impact resins that consists of graft polymerizing alkyl acrylate or alkyl methacrylate monomer, butadiene, and vinyl chloride-containing resin powder by impregnating the vinyl chloride resin with the monomer and irradiating the impregnated powder with ionizing radiation while in contact with gaseous butadiene. The products obtained have superior durability. (auth)

25305 EVIDENCE FOR LONG RANGE TUNNELING BY ELECTRONS TRAPPED IN ORGANIC GLASSES AT LOW TEMPERATURES. Miller, John Robert. Madison, Wis.; Univ. of Wicsonsin (1971). 126p. University Microfilms Order No. 72-2020.

Thesis.

Scavenging of electrons in γ-irradiated organic glasses has for some time been interpreted as a competition of the low concentrations of scavengers with physical trapping sites for mobile electrons. This interpretation seems inconsistent with evidence that electrons are trapped close to their geminate positive ions. An alternative model involving tunneling is explored. The experimental results in 3-methylpentane (3MP) and 2-methyltetrahydrofuran (MTHF) glasses at 77°K indicate that: (1) trapped electron yields decrease exponentially with increasing concentration of added scavenger; (2) transfer of physically trapped electrons to scavengers occurs as a function of time, after trapping; (3) the presence of a scavenger having low electron affinity can increase the yield of the anion of a scavenger of higher electron affinity. These results and several others are consistent with the tunneling model involving capture of electrons prior to their localization in traps. It was concluded that in γ-irradiated 3-methylpentane (3MP) glass, photobleaching of trapped electrons occurred throughout the absorption spectrum suggesting the possibility that the entire spectrum is due to bound-unbound transitions, contrary to previous experimental results and most theoretical treatments. The absorption spectra of trapped electrons in nonpolar hydrocarbon glasses are red shifted if xenon or krypton is incorporated into the glasses. This effect may be due to lowering of the ground state energy for mobile (or "quasifree") electrons by the large and highly polarizable inert gas atoms. The rate of thermal decay of trapped electrons in glassy 3MP was found to increase by nearly a factor of 100 if the temperature is raised from 77 to 81°K. Comparison of the data with data in the literature suggests that the decay process involves both diffusion of the trapped electron, and tunneling of the electron to positive charge of free radicals, but not thermal ejection of the electrons from their traps. The experimental work involved γ radiolysis followed by optical and ESR analysis at low temperatures. Experiments on the millisecond time scale were carried out using low temperature flash photolysis to produce the trapped electrons. (Diss. Abstr. Int., B)

25306 PROGRESS IN APPLICATION OF RADIOACTIVE RAY IN CHEMICAL INDUSTRY. 4. EXAMINATION OF RADIOCHEMICAL PROCESSES FROM ECONOMICAL VIEWPOINT. Machi, Sueo (Japan Atomic Energy Research Inst., Takasaki). Sekiyu To Sekiyu Kagaku; 15: No. 7, 113-17(Jun 1971). (In Japanese).

The costs of irradiation and various processes of radiation chemistry are reviewed. The cost of irradiation is calculated by p = PD/360f, where p is cost required to irradiate 1 kg of a material, P is cost of 1 kw · hr energy, f is availability efficiency of energy, and D is amount of irradiation. P is dependent on cost of irradiation source, cost of building including shielding pool, cost of instruments, operational cost, and cost of depreciation. Explanation was made on polymerization of ethylene by irradiation using a ^{60}Co source. Data were as follows: reaction temperature 200°C, pressure 680 mm Hg, rate of irradiation 3×10^5 rad/hr, rate of polymerization 1,530 g/l-hr, volume of reaction vessel 65 ft^3, inner diameter 2 ft, length 21 ft, ^{60}Co 1.28×10^5 Ci, and efficiency 34%. The costs were calculated for various cases. (Japan)

25307 METHYL GROUP TUNNELLING ROTATION FREQUENCY IN γ-IRRADIATED METHYL MALONIC ACID CRYSTALS. Clough, S.; Hill, J.; Poldy, F. (Univ. of Nottingham, Eng.). J. Phys., C (London); 5: No. 4, 518-28(29 Feb 1972).

At low temperatures in molecular crystals hindered methyl group torsional oscillator–nuclear spin states exhibit an energy splitting that is simply related to the rate of tunnelling rotation of the group through ±120° about the threefold axis. In free radicals in radiation damaged crystals where there exists a large hyperfine interaction between the methyl group protons and the unpaired electron spin, the tunnelling splitting may be measured from the electron nuclear double resonance (ENDOR) transition frequencies. A study at 4.2 K of the free radical $CH_3\dot{C}(COOH)_2$ formed by heat treatment of irradiated methylmalonic acid crystals gave a value of the splitting equivalent in frequency units to 160 ± 30 MHz. It is found that those ENDOR transitions whose frequencies depend most on the tunnelling splitting are anomalously broad. This implies that the splitting has a wide though strongly peaked distribution. Some methyl groups are found to be in states in which the tunnelling splitting is inverted, providing experimental support for theoretical models that have invoked low lying states of this kind to account for the averaging out of the tunnelling splitting at those higher temperatures where classical models for methyl group rotation apply. (auth)

25308 SELECTIVE FREE RADICAL REACTIONS WITH PROTEINS AND ENZYMES: REACTIONS OF INORGANIC RADICAL ANIONS WITH AMINO ACIDS. Adams, G. E. (Mount Vernon Hospital, Middlesex, Eng.); Aldrich, J. E.; Bisby, R. H.; (and others). Radiat. Res.; 49: No. 2, 278-89(Feb 1972).

The radical anions $(CNS)_2^-$, Br_2^-, Cl_2^-, I_2^-, and CO_3^- are selective in their reaction with amino acids. Only methionine, cysteine, and the ring-containing amino acids, tryptophan, tyrosine, histidine, and phenylalanine, show any appreciable reactivity. Absolute rate constants for these reactions, determined by pulse radiolysis, vary with pH due to the ionic equilibrium in the amino acids. The radical products of these reactions show intense transient absorption spectra, which are characteristic of the amino acids. Methods of applying these properties to the study of enzymic activity and protein chemistry are discussed. (auth)

25309 RADIOLYSIS OF TRICAPROIN. LeTellier, Paul Robert. Amherst, Mass.; Univ. of Massachusetts (1971). 184p. University Microfilms Order No. 72-4046.

Thesis.

Tricaproin was irradiated at six megarads and the volatiles formed upon irradiation were isolated by distillation. The compounds identified were separated, according to their proposed mode of formation, into three categories. Twenty-nine compounds were identified and classified as primary radiolytic fragments. These compounds were observed to have been formed by the scission of only one bond in the parent molecule, followed by the gain or loss of a hydrogen atom or cyclization. Quantitative analysis of these components indicated that cleavage of the ester bond (acyloxy–methylene and acyloxy–methine bonds) is the most predominant point of cleavage in irradiated tricaproin. The acyl–oxy bond was found to be the second most radiolabile linkage. Twenty-two compounds fell into the classification of recombination compounds. These components were theorized to have been produced by the recombination of primary radicals (radicals formed by the cleavage of parent molecule bonds). In general, those compounds which originated by the recombination of radicals resulting from the more labile bonds were produced in a greater quantity than those compounds produced from radicals originating from the less labile bonds. The total concentration of the recombination products was much less than that of the primary radiolytic fragments. Secondary products include the remainder of the components that were identified which could not be classified in the above two categories. The total quantity of the compounds identified in this class was less than that of the other two. The reaction mechanisms involved in the formation of these products did not follow an observable pattern. However, in some cases, reaction mechanisms were proposed. (Diss. Abstr. Int., B)

25310 PHOTOSENSITIZED FORMATION OF RADICALS AND SENSITIZED PHOTODESTRUCTION OF POLYPROPYLENE AND POLYISOBUTYLENE AT 77°K. Baider, L. M.; Voevodskaya, M. V.; Fok, N. V. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 5, 378-81(Sep-Oct 1971).

Translated from Khim. Vys. Energ.; 5: No. 5, 422-6(Sep-Oct 1971).

The photosensitized formation of radicals in polypropylene and polyisobutylene at 77°K was investigated. Hexahydropyrene was used as the sensitizer. With the aid of this sensitizer it was shown by the EPR method that the alkyl polymer radicals formed in the primary act of sensitization are photolyzed under the effect of short-wave UV light with the formation of methyl radicals. Similar results were obtained on photolysis of hydrocarbon radicals obtained by γ irradiation of these polymers. It was also established that photosensitization leads to a change of the molecular weight of polypropylene and polyisobutylene. Both rupture of the backbone chain and formation of cross links are observed in polypropylene, whereas only rupture of the backbone chain occurs in polyisobutylene. It is shown that rupture of the polymer chain is not the result of photolysis of the originally formed radicals. (auth)

25311 THERMOLUMINESCENCE OF γ-IRRADIATED n-ALKYL KETONES. Kostin, A. K.; Tochin, V. A.; Revina, A. A.; Nikol'skii, V. G. (Inst. of Electrochemistry, Moscow. Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 5, 369-72(Sep-Oct 1971).

Translated from Khim. Vys. Energ.; 5: No. 5, 411-15(Sep-Oct 1971).

Charged particles formed in irradiated ketones were studied by EPR and thermoluminescence. The following were detected at 77°K: stabilized electrons, $\begin{matrix}R\\R\end{matrix}\!\!>\!C=O^+\downarrow$ primary cation radicals, $\begin{matrix}R_2HC\\R_1\end{matrix}\!\!>\!C=C\rightleftharpoons\dot{O}H$ and $\begin{matrix}R_2HC\\R_1\end{matrix}\!\!>\!\dot{C}-OH$ secondary cation radicals ($R_2 = H$, CH_3, C_2H_5), and $\begin{matrix}R\\R\end{matrix}\!\!>\!\dot{C}=O^-$ anion radicals. It was established that visible light, the presence of acceptors, and the sample temperature affect the stabilized particles. Stabilized electrons are detected only in methyl alkyl ketones. The action of light ($\lambda \geq 350$ nm) on the irradiated ketones leads to a change in the

EPR spectrum, a decrease in the total concentration of paramagnetic particles, and to complete quenching of thermoluminescence. Low-temperature luminescence which is not related to destruction of the paramagnetic particles was detected. (auth)

25312 RADIATION POLYMERIZATION OF CRYSTALLINE VINYL ACETATE (VA). Kritskaya, D. A.; Ponomarev, A. N.; Tal'roze, V. L. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 5, 382-5(Sep-Oct 1971).

Translated from Khim. Vys. Energ.; 5: No. 5, 427-31(Sep-Oct 1971).

The polymerization of crystalline vinyl acetate, initiated by low-voltage electrons, was studied by means of a thin-layer microcalorimeter. It is shown that at 85 to 150°K, polymerization is absent (radiation yield $G < 5$). With an increase of the radiation temperature, beginning at 160°K, the polymerization rate first increases, reaches a maximum at 164.8°K ($G_{max} = 900$), then falls in a relatively narrow temperature range so that at 170°K, $G = 0$. A study of the course of polymerization at maximal values of G made it possible to assess the characteristics of the periods of inception and decomposition of the polymer chain; they were 5 and 20 sec, respectively. It is shown that active centers, leading to polymerization, are formed from charged particles during their monomolecular decomposition. (auth)

25313 ALPHA- AND GAMMA-RADIOLYSIS OF AQUEOUS SOLUTIONS OF AMMONIUM THIOCYANATE. Vladimirova, M. V.; Kulikov, I. A. High Energy Chem. (USSR) (Engl. Transl.); 5: No. 5, 386-90(Sep-Oct 1971).

Translated from Khim. Vys. Energ.; 5: No. 5, 432-6(Sep-Oct 1971).

An investigation is reported of the α- and γ-radiolysis of hydrochloric acid solutions (0.1 N HCl) of NH_4CNS, and the effect of the NH_4CNS concentration on the radiation yields of sulfur, hydrogen, and HSO_4^- ions. An increase in $[NH_4CNS]$ from 0.1 to 8.0 M results in an increase in the yield of sulfur from 1.65 to 4.15 and from 2.92 to 5.40 molecule/100 eV with α- and γ- radiolysis, respectively. It was also found that irradiation of NH_4CNS solutions reduces the initial acidity of the solutions. A complex dependence of the hydrogen yield on the ammonium thiocyanate concentration was observed. With an increase of $[NH_4CNS]$ from 0.1 to 1.0 M, $G(H_2)$ decreases, then with an increase to 3–4 M, $G(H_2)$ increases markedly, and finally with $[NH_4CNS] > 4$ M, $G(H_2)$ shows a sharp fall. The mechanism of radiolysis of ammonium thiocyanate solutions has been examined. On the basis of experimental data, the decomposition yield of water during α-radiolysis was calculated to be 4.2 to 4.3 molecules/100 eV. This yield is much greater than G_{-H_2O} in dilute aqueous solutions of $FeSO_4$ and $Ce_2(SO_4)_3$. (auth)

25314 KINETICS OF THE RADIATION AND THERMAL ADSORPTION OF CO ON γ-Al_2O_3. Gulyaev, G. V.; Kolbanovskii, Yu. A.; Roketashvili, E. B. (Inst. of Petrochemical Synthesis, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 5, 391-5(Sep-Oct 1971).

Translated from Khim. Vys. Energ.; 5: No. 5, 437-42(Sep-Oct 1971).

A model reaction of the radiation-catalytic oxidation of carbon monoxide on γ-Al_2O_3 was studied. Measurements of the rate of adsorption, desorption, and radiolysis were performed from the change in pressure in all-glass vessels of known volume. Irradiation was performed in a ^{60}Co apparatus with a nominal dose rate of 440 R/sec. The kinetic characteristics of the thermal adsorption of CO were studied in the range of pressures from 0.1 to 1.5 mm Hg at 300°K. The thermal desorption of CO was studied in the temperature range from 375 to 573°K. In order to study the kinetics of the radiation chemisorption of CO, the CO + γ-Al_2O_3 system was irradiated with ^{60}Co γ-rays at 300°K after the thermal adsorption–desorption equilibrium had been established. The radiation yield of the adsorption of CO was calculated as 1.3 molecule/100 eV at 300°K. The kinetics of the radiation chemisorption of CO on γ-Al_2O_3 were investigated at 300 to 573°K. (auth)

25315 STUDY OF SURFACE RADIATION DEFECTS IN γ-IRRADIATED SILICA GELS BY THE EPR METHOD. Surin, S. A.; Shelimov, B. N.; Kazanskii, V. B. (Inst. of Organic Chemistry, Kazan). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 5, 396-401(Sep-Oct 1971).

Translated from Khim. Vys. Energ.; 5: No. 5, 443-9(Sep-Oct 1971).

The EPR spectra of γ-irradiated silica gels containing various impurities were compared. The parameters of the EPR spectra of hole centers depends on the impurities in the silica gels and the temperature of the γ-irradiation. The long-wave limits of the photoannealing of the hole centers was determined and a possible mechanism of this process was suggested. The reaction of H_2, CO, NH_3, and C_2H_4 with γ-irradiated silica gels was studied in the range of temperatures from 77 to 300°K, and it was shown that the reactivity of the radiation defects depends substantially on impurities. (auth)

25316 RADIOLYSIS OF MONOOCTYLAMINE. Egorov, G. F.; Dmitrieva, G. V.; Zagorets, P. A. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 5, 419-20(Sep-Oct 1971).

Translated from Khim. Vys. Energ.; 5: No. 5, 468-9(Sep-Oct 1971).

A study was made of the radiolysis of n-octylamine and its mixture with 1-octene (the latter was used as the acceptor of H atoms and radicals), and the radiolysis yields of the main products are reported. The total yields of the saturated and unsaturated C_1 to C_7 hydrocarbons for n-octylamine are equal to 0.5 and 0.05 molecules/100 eV whereas the yields of the corresponding C_1 to C_7 hydrocarbons found under the same conditions for n-octane are 1.6 and 0.32 molescules/eV, almost one order of magnitude greater. Among the hydrocarbon products from the amine, heptane is formed with the greatest yield which indicates the predominant rupture of the C–C bond in the amine molecule in the β-position with respect to the nitrogen atom. (D.H.M.)

25317 COAGULATING EFFECT OF IONIZING RADIATION IN EMULSION POLYMERIZATION OF VINYL CHLORIDE IN THE PRESENCE OF CATIONOGENIC EMULSIFIERS. Smirnov, A. M.; Lukhovitskii, V. I.; Karpov, V. L. High Energy Chem. (USSR) (Engl. Transl.); 5: No. 5, 421(Sep-Oct 1971).

Translated from Khim. Vys. Energ.; 5: No. 5, 470(Sep-Oct 1971).

A study of the process of radiation-initiated emulsion polymerization of vinyl chloride showed that the polymerization in the presence of anionogenic emulsifiers (K-30, MK, potassium laurate) proceeds at a rate of 14 to 25 g/min·liter and with the formation of stable latexes with particle size 500 to 200 Å. Polymerization in the presence of cationogenic emulsifiers (cetylpyridinium chloride, cetylpyridinium bromide, cetyltrimethylammonium bromide, Alkamon OS-2) with other conditions equal, proceeds at considerably lower rates 2 to 5 g/min·liter, but in this case not latexes, but only coarsely dispersed suspensions of poly(vinyl chlorides) in water are formed. (D.H.M.)

25318 EFFECT OF KOH ON THE KINETICS OF THE DISAPPEARANCE OF SOLVATED ELECTRONS IN IRRADIATED METHYL ALCOHOL. Pikaev, A. K.; Sibirskaya, G. K.; Kabakchi, S. A. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 5, 422-3(Sep-Oct 1971).

Translated from Khim. Vys. Energ.; 5: No. 5, 470-2(Sep-Oct 1971).

A study of the effects of KOH on the kinetics of e_s^- disappearance during the pulse radiolysis of methyl alcohol showed that the maximum (λ_{max}) of the e_s^- optical absorption band in neutral methanol was found at 640 nm. In the concentration range studied, the KOH had no effect on the position of λ_{max}; however, the optical density at the end of the pulse increases with increasing KOH concentration. The disappearance occurs by means of a first-order reaction, independent of the KOH concentration. The observed rate constant for the process is essentially constant for KOH concentrations in the range 0.1 to 1.0 M, but it decreases in more concentrated solutions. Possible reasons for the greater lifetime in the alkaline methanol than in neutral methanol are discussed. (D.H.M.)

25319 RADIOLYTIC CONVERSIONS OF NITRATE ION IN NITRIC ACID SOLUTIONS. Bugaenko, L. T.; Roshchektaev, B. M. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 5, 424-5(Sep-Oct 1971).

Translated from Khim. Vys. Energ.; 5: No. 5, 472-4(Sep-Oct 1971).

The mechanisms of the radioinduced decomposition of nitrate ion in concentrated aqueous solutions were studied using the selective acceptor pair, Ce^{4+} and Tl^+ ions. The dependence of radiation yield of NO_2^- formation and Ce^{4+} consumption on HNO_3 concentration is shown. The overall yield of the direct action of irradiation on nitrate ion amounts to 6.8 ± 1.1 ion/100 eV. (D.H.M.)

25320 DETERMINATION OF THE YIELD OF H_2O_2 IN ACIDIC DEAERATED AQUEOUS METHANOL SOLUTIONS. Tret'yakova, N. I.; Nichiporov, F. G. (Inst. of Theoretical and Experimental Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 5, 426-7(Sep-Oct 1971).

Translated from Khim. Vys. Energ.; 5: No. 5, 475-6(Sep-Oct 1971).

The dependence of $G_{H_2O_2}$ on the concentrations of the acceptors

CH_3OH, C_2H_5OH, and Br^- is described by a single curve. The effects of pyrolysis of vapors from the solution caused by the ampoule-sealing procedure were investigated. Values of $G_{H_2O_2}$ were higher in experiments without sealing and do not contradict the idea that OH radicals are the precursors of molecular H_2O_2. (M.C.G.)

25321 DISSOCIATIVE CAPTURE OF ELECTRONS IN RADIOLYSIS OF MONOCARBOXYLIC ACID ANHYDRIDES. Chervonenko, V. S.; Roginskii, V. A. High Energy Chem. (USSR) (Engl. Transl.); 5: No. 5, 428-9(Sep-Oct 1971).

Translated from Khim. Vys. Energ.; 5: No. 5, 476-8(Sep-Oct 1971).

The investigation was conducted with amorphous samples at 77°K by EPR, optical spectroscopic, and gas chromatographic methods. Acyl radicals apparently arise as a result of the reaction $RCH_2COOCOCH_2R + e^- \rightarrow RCH_2C{=}O + RCH_2COO^-$. Under the action of visible light the acyl radicals not only dissociate but also split out an H atom from an anhydride molecule. Alkyl radicals are formed also in the radiolysis. (M.C.G.)

25322 KINETICS OF THE γ-RAY INDUCED POLYMERIZATION OF ETHYLENE IN 1,2-DICHLOROTETRAFLUOROETHANE. Suganuma, Fujio; Hagiwara, Miyuki; Mitsui, Hiroshi; Kagiya, Tsutomu (Japan Atomic Energy Research Inst., Takasaki). Bull. Chem. Soc. Jap.; 45: No. 2, 500-5(Feb 1972).

The γ induced polymerization of ethylene in bulk or in solution in the presence of 26.9 to 67.3 g of 1,2-dichlorotetrafluoroethane (R-114) was carried out in a 100-ml reactor under a pressure of 210 to 400 kg/cm² and at 30°C, with a dose rate of 1×10^4 to 9×10^4 rad/hr. The rate of the polymerization and the molecular weight of the polymer formed increased with the reaction time and the pressure. The rate also increased upon the addition of an appropriate amount of R-114. On the other hand, the molecular weight decreased with an increase in the amount of R-114. The dose-rate exponents of the rate and the molecular weight were found to be 0.8 and −0.2, respectively. These results were analyzed kinetically, and the rates and the rate constants of the initiation, propagation, transfer, and termination reactions were evaluated. Further, the roles of R-114 in the polymerization were discussed. (auth)

25323 PICOSECOND PULSE RADIOLYSIS SYSTEM: STUDIES OF THE SOLVATED ELECTRON. Bronskill, Michael John. Toronto; Univ. of Toronto (1970). National Library of Canada at Ottawa.

Thesis.

A pulse radiolysis system was developed that is capable of time resolution to less than 20 psec (20×10^{-12} sec). The transient, light-absorbing species produced in liquids by the fine-structure pulses from a 40-MeV electron linear accelerator are detected using the Cherenkov light flashes produced in air by the electron beam as analyzing light flashes. A variable-length optical system is used to delay the analyzing light flashes before focusing them through the irradiated liquid sample. Variations in the transmitted light level, integrated over many fine-structure pulses, are monitored as a function of the length of the optical delay path. The optical, mechanical, and electronic systems developed to retrieve this small absorption signal from a noisy background and display it as a function of time are described in detail. This picosecond pulse radiolysis system was used to observe the solvated electron (e^-_{aq} in water, or e^-_{sol} in general) in water and the common aliphatic alcohols in the time interval from ~20 to 350 psec. The spectrum of the solvated electron in water and methanol at these times is identical to the spectrum measured at μsec times with conventional pulse radiolysis systems. Molar concentrations of acid were used to scavenge e^-_{aq}, and $k(e^-_{aq} + H^+_{aq})$ was measured as $(1.2 \pm 0.2) \times 10^{10}$ liter mole-sec for $[H^+_{aq}]$ from 0.5 to 5.0 M. The factors limiting the time response of the picosecond pulse radiolysis system are discussed in terms of a mathematical model. This model is compared to the observed risetimes of e^-_{sol} absorption signals, and the time of formation of e^-_{sol} is estimated to be less than 10 psec for all solvents studied. The yield of solvated electrons in alcohols at picosecond times was measured to be approximately one-third of the yield in water. This result agrees with the relative e^-_{sol} yields in alcohols measured at μsec times. The rate of reaction of e^-_{aq} with molar concentrations of scavengers (acetone, H_2O_2, NO_2^-, NO_3^-, Cd^{2+}) was measured. The measured reaction rates agree within a factor of two with the rates determined at low scavenger concentrations by μsec pulse radiolysis. The differences between these rates are attributed to ionic strength effects. The yield of the solvated electron in water at 30 psec was determined by measuring the dose received by the sample along the path of the analyzing light beam using perspex HX sheets. The measured dose is related to the e^-_{aq} absorption signal observed at 575 nm, and the yield of e^-_{aq} is calculated to be 3.2 ± 0.5 per 100 eV of energy absorbed. The errors in this measurement are discussed in detail. The rate of decay of the solvated electron was monitored in the absence of scavengers over the time interval from 30 to 350 psec. Within the limits of a low signal-to-noise ratio, there is no observable e^-_{aq} decay in this time interval. This observation, and the measured yield of e^-_{aq}, are discussed with respect to the spur diffusion model for the radiolysis of aqueous solutions. Two changes to the spur diffusion model are suggested, and the probable time scale for the early life of the solvated electron is outlined. (Diss. Abstr. Int., B)

25324 STRUCTURE AND REACTIVITY OF ORGANIC IONS IN GAS-PHASE RADIOLYSIS. III. THE BENZENONIUM IONS FORMED BY THE REACTIONS OF CH_5^+ AND $C_2H_5^+$ IONS FROM METHANE WITH o-XYLENE. Yamamoto, Yukio; Takamuku, Setsuo; Sakurai, Hiroshi (Osaka Univ.). Bull. Chem. Soc. Jap.; 45: No. 1, 255-8(Jan 1972).

The gas-phase γ radiolysis of mixtures of o-xylene and excess methane was studied at room temperature as a function of methane pressure and the added NO and NH_3 in order to investigate the reactions of CH_5^+ and $C_2H_5^+$ ions from methane with o-xylene. It is suggested that the proton transfers from these ions to o-xylene result in the isomerization to m-xylene via an intermediate σ complex, dimethylbenzenonium ion, and that a part of the $C_2H_5^+$ ions is added to o-xylene leading to the formation of two isomers of dimethylethylbenzene. The proposed mechanism of the methane-sensitized isomerization of o-xylene to meta isomer is supported by the observation that both m-xylene-d_0 and m-xylene-d_1 were formed in the radiolysis of a mixture of o-xylene and methane-d_4. The isotope effect (k_H/k_D) on the proton loss from the dimethylbenzenonium ion was roughly estimated to be 1.8 ± 0.4. Group migration of intermediate σ complexes is discussed. (auth)

25325 ENDOR STUDY OF THE TRAPPED ELECTRON IN IRRADIATED ORGANIC GLASSES. Iwasaki, Machio; Muto, Hachizo; Eda, Bunzo; Nunome, Keichi (Government Industrial Research Inst., Nagoya, Japan). J. Chem. Phys.; 56: No. 6, 3166-8(15 Mar 1972).

The ENDOR signal due to a trapped electron in irradiated organic glasses was observed using a high-power pulsed radio-frequency technique. Glasses of 2-methyltetrahydrofuran were irradiated and spectra were obtained when the ESR signal of the trapped electron was partially saturated and also after photobleaching of the ESR signal of the trapped electron with visible light. The difference between the two spectra indicated that the signal near the free proton frequency arises from the protons that interact with the trapped electron. (M.C.G.)

25326 ELECTRONIC PROCESSES IN ULTRAVIOLET AND PULSE IRRADIATED HALIDE ION SYSTEMS. THE EFFECT OF HEAVY ATOMS. Khorana, Shamsher; Merkel, Paul B.; Hamill, William H. (Univ. of Notre Dame, Ind.). J. Chem. Phys.; 56: No. 6, 2807-13(15 Mar 1972).

Air-free, concentrated, aqueous solutions of alkali halides at ~20°C containing small concentrations of heavy metal ions or I_2 were uv irradiated in the induced absorption bands. There was no evidence of chemical change unless an electron acceptor, e.g., N_2O was also present when halide oxidation occurred. Luminescence from 1M KCl with 10^{-4}M Tl^+ was quenched by N_2O and by I^-, both systems obeying Stern–Volmer kinetics. In 8M LiCl glass saturated with TlCl, there were three absorption bands at 235, 217, and 187 nm at 77°K. They resemble, both in position and relative intensity, the A, B, and C bands of KCl : Tl^+. Analogous results were observed for Tl^+-doped aqueous glasses of LiBr and LiI, and all may involve the known halocomplexes of Tl^+. The absorption bands in the systems examined are attributed to charge transfer from halide ion to heavy metal cation or to iodine. The relevance of these results to Tl^+-doped alkali halide crystals is also considered. The absorption spectra of the diatomic halides MX (GaX, InX, and TlX) with $^1\Sigma^+$ ground states have in common $^3\Pi_0^+$, $^3\Pi_1$, and $^1\Pi_1$ excited states. These may correlate with A_1, A_2, and C bands in ionic lattices. If MX is nearly substitutional in the alkali halide lattice, there are three distinguishable metal–halogen internuclear separations, which may account for structure in the C band through Franck–Condon effects. LiCl glass γ-irradiated at 77°K shows absorption by Cl_2^- and by trapped electrons and recombination luminescence, induced by optical bleaching of trapped electrons, has both 1 and 9 sec lifetimes. The luminescence and chemical reactivity are attributed to excited halide ions. Pulse radiolysis of neutral chloride ion aqueous solutions is known to yield Cl_2^-. It was found that aeration affects $G(Cl_2^-)$ and, in solutions saturated with N_2O or CO_2 instead of N_2, yields of Cl_2^- are considerably enhanced. (auth)

25327 RADIATION CHEMISTRY OF GASEOUS METHANE. Reed, Phillip Ralph. Lafayette, Ind.; Purdue Univ. (1971). 227p. University Microfilms Order No. 72-8016.

Thesis.

Methane in the gas phase at 700 torr and at ambient temperature was irradiated with ^{60}Co gamma rays. Hydrogen, ethane, propane, butane, isobutane, and pentane were the observed products. Product yields from methane were investigated in mixtures of methane containing acetylene, ethylene, propylene, nitric oxide, and oxygen as a function of the concentration of the additive. Additive concentrations were normally increased from 0.02 to 10 mole %. In those experiments using acetylene and ethylene as additives, carbon-14 acetylene and carbon-14 ethylene were added to several samples in order to distinguish those products formed from methane. The experimental hydrogen yield in pure methane was 5.48 ± 0.09 molecules/100 eV. All hydrogen yields from methane decreased to limiting values with increasing additive concentration. Extrapolation of the limiting hydrogen yields to zero additive concentration gave a mean non-scavengeable hydrogen yield of $G_{H_2} = 2.76 \pm 0.04$. An initial hydrogen yield, $G(H_2)^\circ = 6.54 \pm 0.15$, and a hydrogen atom yield, $G_H = 3.78 \pm 0.14$, from methane were determined from a kinetic analysis of the hydrogen yields in the methane + additive mixtures. A mechanism consisting of the primary ionization process, excitation, ion-molecule, and radical reactions was capable of accounting for the initial hydrogen, hydrogen atom, and nonscavengeable hydrogen yields in pure methane. Ratios of rate constants were determined for the reactions of the hydrogen atom abstraction with methane and the hydrogen atom addition to the additive. In pure methane, the experimental $G(C_2H_6)$ was 2.16 ± 0.03. All ethane yields decreased to limiting values as the concentrations of acetylene, ethylene, propylene, and nitric oxide were increased. No ethane yields were observed when oxygen was present in concentrations greater than 0.89 mole %. No unsaturated products were detected in the radiolysis of pure methane. Irradiation of methane with added O_2 (0.021%), NO (0.054%), C_2H_6 (0.039%), and C_2H_2 (0.042%) gave $G(C_2H_4)$ values of 0.84, 0.93, 0.83, and 1.28 molecules/100 eV, respectively. Yields of ethylene decreased to limiting values as the concentrations of nitric oxide and oxygen were increased, but the ethylene yields increased to a limiting value as the propylene concentration was increased. In the methane + acetylene mixtures that contained carbon-14 acetylene, carbon-14-labeled ethylene was observed. The ethylene yield from methane accounted for 34, 46, and 62% of the total ethylene yield observed in mixtures that contained 0.09, 2.1, and 9.0% acetylene, respectively. Yields of acetylene, propylene, and butene-1 in pure methane were estimated by extrapolating their respective yields obtained in the methane + additive mixtures to zero additive concentration. Values of $G(C_2H_2) = 0.031 \pm 0.003$ and 0.041 ± 0.005 and $G(1\text{-}C_4H_8) = 0.017 \pm 0.003$ and 0.027 ± 0.003 were determined with ethylene and propylene as additives, respectively. Values of $G(C_3H_6) = 0.05 \pm 0.01$ and 0.021 ± 0.003 were determined with added acetylene and ethylene. Other significant products observed during the radiolysis of methane + additive mixtures included benzene and a yellow solid with added acetylene; propane, butane, and cyclopropane with added ethylene; methylcyclopropane with added propylene; nitrogen and nitrous oxide with added nitric oxide; and carbon dioxide with added oxygen. (Diss. Abstr. Int., B)

25328 EFFECTS OF REACTOR RADIATION ON THE NITROGEN–HYDROGEN–ALUMINA SYSTEM. Aleta, Carlito Ronquillo. Ithaca, N. Y.; Cornell Univ. (1971). 147p. University Microfilms Order No. 72-7533.

Thesis.

A study was undertaken of the effects of reactor radiation on the nitrogen–hydrogen gas mixture, with and without the presence of a solid. Reactor radiation, fast neutrons plus gamma rays, was chosen because of the high intensity of radiation available that makes suitable the study of slow reactions, such as ammonia synthesis: $3H_2 + N_2 = 2NH_3$. The first part of the study involved millisecond pulse irradiations of the gas mixture at room temperature. The measured yield of ammonia was found to be less, for the same total dose, when compared with measurements by others using continuous irradiation. The low measured yield found in this study was attributed to the adsorption of ammonia on the surface walls of the containing vessel and associated tubing. The second part was concerned with the gas reaction in the presence of powdered alumina. The alumina was either preirradiated separately or irradiated concurrently with the gas using reactor radiation. Alumina was chosen because it had been reported to enhance the ammonia yield when concurrently irradiated with the gas mixture using gamma rays alone. Investigations using mixed gamma and fast neutron radiation on the nitrogen–hydrogen–alumina system have not been reported before. Evidence available from the literature indicates that the induced effects on alumina by mixed radiation and by gamma rays are different. An apparatus was therefore built so flow experiments could be conducted inside the Cornell University TRIGA reactor 6W beamport. Experiments using preirradiated alumina were conducted outside the beamport, and both concurrent and nonconcurrent irradiation experiments were done inside the beamport. Alumina that had been preirradiated with reactor radiation was found to catalyze the ammonia reaction. Previous reports indicated that preirradiation with pure gamma rays failed to make the alumina active. The induced catalytic activity was therefore attributed to the effects of fast neutrons on the solid. A synthesis rate of 0.3×10^{-6} micromoles/sec-gram was observed at 450°C for a 50%–50% nitrogen–hydrogen gas mixture at 70 psig for a total preirradiation dose of 1.7×10^{16} nvt. Concurrent irradiation of the gas-alumina system, in the presence of a preirradiated active solid, did not enhance the yield of ammonia. This result contradicts the energy transfer hypothesis, which explains successfully the results of experiments using gamma rays alone on a similar gas–alumina system. The cause of the anomalous behavior is attributed to the introduction of defects in the solid by neutron collisions resulting in a semiconductor behavior of the solid. Semiconductors are less efficient, or show no effects at all, in the transfer of energy. Calculations based on a modified Kinchin–Pease model gave the number of atomic displacements as $\sim 6 \times 10^{16}$ atoms/gram-hour. Comparison of the number of charge carriers in intrinsic semiconductors ($< 10^{14}$ carriers/gram) and in extrinsic semiconductors ($\sim 10^{17}$ to 10^{18} carriers/gram) shows that the concentration of structural defects due to fast neutron bombardment can modify the insulator properties of alumina. The activity of alumina was found to decrease with prolonged irradiation as indicated by the decrease in the yield of ammonia. As much as 75% decrease in the synthesis rate was observed at 450°C by increasing the fluence from 8.4×10^{16} to 1.2×10^{17} nvt. A possible cause of the decrease in yield is the decrease in surface area of the alumina catalyst. (Diss. Abstr. Int., B)

25329 ELECTRON SPIN RESONANCE OF X-IRRADIATED HEPTANAL TRAPPED IN A SINGLE CRYSTAL OF PERHYDROTRIPHENYLENE. Ciecierska-Tworek, Zofia; Birrell, G. Bruce; Griffith, O. Hayes (Univ. of Oregon, Eugene). J. Phys. Chem.; 76: No. 7, 1008-12(30 Mar 1972).

Free radicals trapped in x-irradiated heptanal oriented in a single crystal of perhydrotriphenylene were investigated using electron spin resonance techniques. An analysis of the data indicates the presence of two free radicals: a short-lived radical, $CH_3(CH_2)_4\dot{C}HCHO$, and a stable semidione radical, $CH_3(CH_2)_5\text{-}\dot{C}OHCO(CH_2)_5CH_3$. All spectra are well resolved and agree with computer-simulated spectra. A table of proton coupling constants and g values is given. (auth)

25330 TRANSIENT ELECTRONS IN PULSE-IRRADIATED CRYSTALLINE WATER AND DEUTERIUM OXIDE ICE. Nilsson, G. (Aktiebolaget Atomenergi, Nykoeping, Sweden); Christensen, H.; Pagsberg, P.; Nielsen, S. O. J. Phys. Chem.; 76: No. 7, 1000-8(30 Mar 1972).

Crystalline samples of H_2O and D_2O ice were irradiated with electron pulses from a Linac and the optical absorption spectrum of the transient electron was recorded at different temperatures from −5 to −190°C. At −10° the position of the absorption peaks in the two matrices are at 682 (1.82 ± 0.01 eV) and 668 nm (1.86 ± 0.01 eV), respectively. The peak energy continuously increases as the temperature becomes lower, and at about −130° constant values of 1.90 and 1.94 eV are reached. The electron decay could be accounted for by a second-order reaction between the electron and a species present in a concentration greater than its own. This second species is very probably the proton, and the proton excess was found to increase as the temperature decreases. The rate constants for the reaction in H_2O and D_2O ice at −10° are $(1.95 \pm 0.06) \times 10^{11}$ and $(0.42 \pm 0.04) \times 10^{11}$ M^{-1} sec^{-1}, respectively, and the activation energies are 4.5 ± 1.0 and 6.8 ± 1.0 kcal/mol. The yield of electrons (G) decreases rapidly from 0.95 at −5° to 0.05 at −50°. An interpretation of the kinetics giving reasonable explanation to this fact is presented. (auth)

25331 COMPETITIVE ELECTRON-SCAVENGING EXPERIMENTS IN THE RADIOLYSIS OF HYDROCARBONS. KINETICS OF THE REACTIONS OF SECONDARY IONS. Infelta, Pierre P.; Schuler, Robert H. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 76: No. 7, 987-99(30 Mar 1972).

A detailed kinetic treatment of the effect of secondary electron transfer reactions in the irradiation of hydrocarbon solutions containing two electron scavengers is given. It is shown that the possible extent of secondary reactions is limited by the short lifetime of most of the geminate ion pairs. Expressions are developed to describe the concentration dependence of product formation in two solute systems, and these expressions are applied to competitive studies using CH_3Br or CH_3Cl as indicator solutes.

Results are presented on binary systems containing SF_6, N_2O, or CO_2 from which the reactivities of these solutes toward electrons are obtained. In competition between CH_3Cl and each of these solutes the methyl radical yield is found to be lower than expected, presumably as the result of the removal of metastable CH_3Cl^- radical anions by electron transfer processes. Analysis of the results indicates that the lifetime of this anion is $\sim 3 \times 10^{-6}$ sec. Methyl bromide behaves very nearly ideally in competition with both SF_6 and N_2O as a result of a low transfer rate and/or rapid autodissociation of the radical anion. In competition with CO_2, however, spuriously high methyl radical yields are observed. Because of this, considerable caution is indicated in the interpretation of results from competitive studies with methyl bromide. (auth)

25332 RADIOLYSIS OF AQUEOUS SOLUTIONS OF AMINO ACIDS AND NITROUS OXIDE. Block, Oliver Ulfert John. Manhattan, Kan.; Kansas State Univ. (1971). 101p. University Microfilms Order No. 72-9753.

Thesis.

The chemical effects of ^{60}Co gamma radiation on aqueous solutions were studied. Solutes used in the irradiated solutions were amino acids, nitrous oxide, and methanol. The extent of impurity and product competition with added solutes was carefully considered. A mechanism for the radiolysis of aqueous amino acid solutions accounted for $G(H_2)$ decreasing to G_{H_2} as the concentration of nitrous oxide (solvated electron scavenger) increased. Molecular hydrogen was formed by reactions of the solvated electron with the amino acids and not by reactions of the hydrogen atom. Measured yields also indicated the formation of NH_3 or H_2 by reactions of excited water molecules with the amino acids. The mechanism also accounted for the increased yields of NH_3, CO_2, and RCHO with increased nitrous oxide concentration. The mechanism which was basically similar to previous mechanisms modified the relative importance of reactions involved in the mechanism. A consistent set of rate constants for amino acids with the solvated electron were measured relative to nitrous oxide. The reactivities of the amino acid functional group and the amino acid side chain towards primary radicals correlated with the measured yields of H_2, NH_3, CO_2, and RCHO. Reactive side chains protected the amino acid functional group. The yields of N_2 and H_2 from irradiated nitrous oxide–methanol aqueous solutions (1.2×10^{-3} M $\leq [N_2O] \leq 7.8 \times 10^{-3}$ M and 0.1M $\leq [CH_3OH] \leq$ 0.31M) did not depend on methanol concentration or total dose (1.2×10^{18} eV/g and 1.2×10^{19} eV/g). The measured yield of H_2 ($G(H_2) = 0.78$ molecules/100 eV absorbed) did not depend on nitrous oxide concentration and was lower than $G_H + G_{H_2}$. The increased yield of N_2 with an increase in N_2O was accounted for by scavenging of e^-_{aq} from the spurs and by competition of products and impurities for e^-_{aq}. (Diss. Abstr. Int., B)

25333 EPR STUDY OF IRRADIATED METHYL SULFOXIDE. Machado, J. C.; Debuyst, R.; Dejehet, F.; Apers, D. Radiochem. Radioanal. Lett.; 9: No. 5-6, 363-71(31 Mar 1972). (In French).

Two radicals were observed on low-temperature uv and γ irradiation of polycrystalline methyl sulfoxide. One of them was identified as CH_3. The other one shows a spectrum with g values $g_1 = 2.020$, $g_2 = 2.009$, $g_3 = 2.002$ and might be attributed to CH_3SO. (auth)

25334 OBSERVATION OF X-RAY- AND U.V.-INDUCED LUMINESCENCE AND ABSORPTION DURING AND AFTER IRRADIATION. Steen, Harald B.; Soerensen, Otto I.; Holteng, Jan Aa. (Norsk Hydro Inst. for Cancer Research, Oslo). Int. J. Radiat. Phys. Chem.; 4: No. 1, 75-86(Feb 1972).

An apparatus is described by which the x- and uv-induced emission and absorption of solutions and solid materials can be studied during, as well as after, irradiation at any temperature between 77 and 330°K. Fluorescence and phosphorescence spectra can be obtained separately and simultaneously. The emission spectra of phenanthrene observed during irradiation with x rays and uv light at 77°K are compared, and the kinetics of the formation and decay of trapped electrons in a glycol + water glass, as observed during and after irradiation with x rays and intense uv light, are demonstrated. (auth)

25335 LIGAND-TO-METAL INTRAMOLECULAR ELECTRON TRANSFER IN THE REDUCTION OF p-NITROBENZOATOPENTAAMMINECOBALT(III) ION. Hoffman, Morton Z. (Boston Univ.); Simic, M. J. Amer. Chem. Soc.; 94: No. 5, 1757-9(8 Mar 1972).

The reaction of radiolytic e^-_{aq} and the reducing radicals $\cdot CO_2^-$ and $(CH_3)_2COH$ with $p\text{-}O_2NC_6H_4CO_2Co(NH_3)_5^{2+}$ generates a transient intermediate in which the transferred electron is localized on the coordinated p-nitrobenzoato ligand. Electron pulse radiolysis of the cobalt complex indicated that the transient intermediate is formed and that it decays via ligand-to-metal intramolecular electron transfer. (M.C.G.)

25336 ION CYCLOTRON RESONANCE SPECTROSCOPY IN STRUCTURE DETERMINATION. II. PROPYL IONS. McAdoo, David J.; McLafferty, F. W.; Bente III, Paul F. (Cornell Univ., Ithaca, N. Y.). J. Amer. Chem. Soc.; 94: No. 6, 2027-33(22 Mar 1972).

Conflicting postulations were made for the structures of $C_3H_7^+$ ions found in the mass spectra of various organic compounds; similar discrepancies are found in radiolysis and theoretical studies of these ions. Ion cyclotron resonance (icr) spectroscopy was used to examine proton-deuteron transfer and other ion–molecule reactions of specifically labeled propyl ions from a variety of precursors. Nondecomposing sec-propyl ions are found to undergo little (<20%) isomerization in the time required for icr reactions (ca. 10^{-3} sec). Almost no (<3%) $n\text{-}C_3H_7^+$ ions retain their structure; most (80 to 100%) isomerize to $sec\text{-}C_3H_7^+$. Protonation of cyclopropane produces propyl ions whose reactivity toward methanol is identical with the unique reactivity of $sec\text{-}C_3H_7^+$. This result indicates either that $\Delta H_f(c\text{-}C_3H_7^+)$ is significantly higher than $\Delta H_f(sec\text{-}C_3H_7^+)$(ca. 7 kcal/mol), or that $c\text{-}C_3H_7^+$ isomerizes to $sec\text{-}C_3H_7^+$. (auth)

25337 RELATIVE ABUNDANCES AND RECOIL ENERGIES OF FRAGMENT IONS FORMED FROM THE X-RAY PHOTOIONIZATION OF N_2, O_2, CO, NO, CO_2, AND CF_4. Carlson, Thomas A.; Krause, Manfred O. (Oak Ridge National Lab., Tenn.). J. Chem. Phys.; 56: No. 7, 3206-9(1 Apr 1972).

A specially designed mass spectrometer was used to study the fragment ions following x-ray photoionization of several simple gaseous molecules, containing only first-row elements. Two photon sources were used: CuL_α(930 eV) and CK_α(280 eV). The higher-energy x-ray source produced initial vacancies primarily in the K shells of the different elements, while the lower-energy radiation produced ionization entirely in the valence shells. Data were obtained as a function of collection voltage, and relative abundances of the fragment ions were evaluated under conditions of equal collection efficiency. From the shape of the collection efficiency curve the average recoil energies were estimated. The results are briefly discussed in terms of the effect of the KLL Auger processes and multiple ionization. (auth)

25338 PULSE RADIOLYSIS STUDIES IN LANTHANIDE AQUEOUS SOLUTIONS. II. FORMATION, SPECTRUM, AND SOME CHEMICAL PROPERTIES OF PRASEODYMIUM(IV) IN AQUEOUS SOLUTION. Faraggi, M.; Feder, A. (Nuclear Research Centre-Negev, Beer-Sheva, Israel). J. Chem. Phys.; 56: No. 7, 3294-7(1 Apr 1972).

Pulse radiolysis of Pr(III) gives a transient absorption spectrum with a maximum at 290. This is due to the formation of Pr(IV) through the reaction of OH radicals and Pr(III). The rate of the reaction was determined by four different methods and the rate constant was found to be 1 to $4 \times 10^6 M^{-1}$ sec^{-1}. The variation of the optical density of Pr(IV) ions with pH lead to the conclusion that the form of Pr(IV) is $Pr(OH)^{3+}$ and Pr^{4+} in neutral and acid solutions, respectively. The equilibrium constant of hydrolysis, $Pr^{4+} + H_2O \rightleftharpoons Pr(OH)^{3+} + H^+$, was found to be 7×10^{-4}. The spectrum obtained is assigned to the Laporte-allowed transition between 4f and 5d. The specific reaction rate constants of Pr(IV) with water, HSO_4^-, NO_2^-, H_2O_2, and Br^- were determined, as well as those of Pr(III) with e^-_{aq} and H atoms. (auth)

25339 PULSE RADIOLYSIS IN LANTHANIDES AQUEOUS SOLUTIONS. I. FORMATION SPECTRUM AND CHEMICAL PROPERTIES OF DIVALENT EUROPIUM, YTTERBIUM, AND SAMARIUM IONS. Faraggi, M.; Tendler, Y. (Nuclear Research Centre-Negev, Beer-Sheva, Israel). J. Chem. Phys.; 56: No. 7, 3287-93(1 Apr 1972).

The reactions of hydrated electrons with Eu(III), Yb(III), and Sm(III) were investigated. Absorption spectra of transient species produced by the pulse of electrons were obtained and assigned to the Laporte allowed transition between $4f^n$ and $4f^{n-1}$ 5d levels of the divalent ions. The excitation energy values E_{fd} for these ions in aqueous solution are in good agreement with those found or calculated in crystal. The specific rates of reactions of Eu(II), Yb(II), and Sm(II) with OH radicals, O_2, N_2O, H_2O_2, NO_2^-, NO_3^-, BrO_3^-, IO_3^-, Cu^{2+} and the electron transfer reaction of Sm(II) with Yb(III) and with Eu(III) were determined. The order of reactivity is Sm(II) > Yb(II) > Eu(II); this order is correlated with the electrode potential E^0 of divalent ions. (auth)

25340 SHORT-LIVED FREE RADICALS IN AQUEOUS SOLUTION OF PURINES. Nicolau, Claude (Univ. of Craiova, Rumania). Rev. Roum. Chim.; 17: No. 1-2, 411-20(Jan-Feb 1972).

Paramagnetic transients were detected by means of ESR spectroscopy in aqueous solutions of purines following reaction with chemically generated OH radicals in a flow-system. The adducts formed were addition products at C (8) in the imidazole ring. The

same type of adducts were observed when amino radicals instead of OH radicals were reacted with the organic molecules. Aliphatic alcohol free radicals were generated by reaction with OH' and then subsequently reacted with caffeine. The splitting constants and g-factors together with computer simulation of the ESR spectra allowed the elucidation of the structure of the adducts and of their mechanism of formation. In the same three-way flow system the fast reaction of molecular repair of free radicals by sulfhydryls and disulfides were followed and their mechanism discussed. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 25245 and 25288.

Hot-Atom Chemistry

Refer also to abstract 25337.

25341 (ORO-3346-94) PRECISION DETERMINATION OF THE K X-RAY FLUORESCENCE YIELD OF ARSENIC FROM THE RADIOACTIVE DECAY OF SOLID ^{75}Se SOURCES. Chew, William Mahlon (Georgia Inst. of Tech., Atlanta). Mar 1972. Contract AT(40-1)-3346. 78p. Dep. NTIS.

Thesis.

There appear to be two classes of experimental values for K-shell fluorescence yields, ω_K, in the low-to-middle-Z region: measurements using gaseous radioactive sources or fluorescent excitation of nonradioactive gaseous targets and measurements utilizing solid radioactive sources or solid nonradioactive targets. The first class gives somewhat higher values of ω_K and are presumed to be the more accurate. A precision measurement of $\omega_K = 0.589 \pm 0.027$ for Z = 33 (arsenic) was made through the use of a solid radioactive ^{75}Se source. The errors consist of a 2 σ statistical error added linearly to the systematic error. The value is in good agreement with $\omega_K = 0.587$ for the same Z obtained by Pahor, Kodre, and Moljk, who utilized the method of fluorescent excitation of nonradioactive gaseous AsH_3 in a multiwire proportional counter. Therefore, there is no difference between the two types of measurements, at least for Z = 33. During the course of the investigation, a method of calibrating the absolute emission rates of low-energy (<30 keV) photon-emitting radioactive sources was developed. (auth)

25342 EXPERIMENTAL INVESTIGATION ON THE SOLID STATE ISOTOPIC EXCHANGE MODEL FOR THE ANNEALING OF SZILARD-CHALMERS RECOILS. Lazzarini, E.; Fantola-Lazzarini, A. L. (Centro Studi Nucleari, Milan). J. Inorg. Nucl. Chem.; 34: No. 3, 817-24(Mar 1972).

Using the solid state isotopic exchange model advanced by Nath et al (Indian J. Chem. 4:51(1966)) to explain the thermal annealing of Szilard-Chalmers recoils it can be deduced that, if the recoils can anneal by exchange with isotopic species in two different crystal sites, the two annealing rates must be equal. The different activation energies required for the isotopic exchange reactions between recoil species and atoms occupying different kinds of lattice sites can only affect probabilities but not rates. This prediction was investigated by studying the isochronal annealing of Szilard-Chalmers recoiled species produced by neutron irradiation of cis-$[Co(en)_2(NO_2)_2][CoEDTA] \cdot 3H_2O$. The experimental results both for annealing in air and in vacuo support this prediction. It was found that the presence of oxygen enhances the extent of annealing of recoils in the cationic and anionic part of the irradiated compound, though in a different manner. Analogous experiments were also carried out on cis-$[Co(en)_2C_2O_4][CoEDTA] \cdot 4H_2O$ and cis-$[Co(en)_2(CN)_2][CoEDTA] \cdot 4H_2O$, but they were inconclusive as the very different degrees of annealing of the recoils in the cationic and anionic part of the complexes make it very difficult to ascertain whether or not the annealing curves for the cationic and anionic parts are mutually correlated. (auth)

25343 EFFECTS OF PRE-IRRADIATION TREATMENTS ON THE CHEMICAL BEHAVIOR OF ^{115}Cd RECOIL ATOMS IN NEUTRON IRRADIATED CADMIUM PHTHALOCYANINE. Kudo, Hiroshi (Japan Atomic Energy Research Inst., Tokai). J. Inorg. Nucl. Chem.; 34: No. 2, 453-60(Feb 1972).

The chemical behavior of ^{115}Cd recoil atoms was studied in cadmium phthalocyanine which had been subjected to pre-irradiation treatments such as quenching, irradiation with γ rays, or irradiation in a nuclear reactor. It was found that the initial retention of the quenched sample was smaller than that of the untreated sample, and that the difference between the initial and the plateau retention, ΔR, increased when the sample had been quenched from 190°C. Only a small change in the behavior of the recoil atoms was observed in both cases of irradiation prior to the recoil reaction. The results are discussed in terms of the defects; the central metal vacancies introduced in the complex by quenching has a big effect on the subsequent course of the thermal annealing reaction. (auth)

25344 REPLACEMENT OF HYDROGEN BY FAST TRITIUM ATOMS. Dzantiev, B. G.; Shimchuk, O. S.; Shishkov, A. V. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 5, 402-4(Sep-Oct 1971).

Translated from Khim. Vys. Energ.; 5: No. 5, 450-3(Sep-Oct 1971).

A study was made of the replacement of hydrogen by tritium atoms accelerated to energies from 0.4 to 5 keV. The construction of an apparatus for producing a controlled-energy beam of tritium atoms by charge exchange between tritium ions and hydrogen is described. It is shown that if acetylene, cyclohexane, hexane, cyclohexene, and benzene are bombarded by this beam, the main tritiated products are the parent compounds and their yield is independent of the energy of tritium atoms. Bombardment of cyclohexene yielded, in addition to tritiated cyclohexane, a range of products resulting from the rupturing of the C–C bond. This range of products is compared qualitatively with that produced by reaction with thermal atoms of tritium. (auth)

25345 CHEMICAL BEHAVIOR OF ^{64}Cu RECOIL ATOMS IN THE MIXED SYSTEM OF COPPER PHTHALOCYANINE AND METAL-FREE PHTHALOCYANINE. Kudo, Hiroshi (Japan Atomic Energy Research Inst., Tokai). Bull. Chem. Soc. Jap.; 45: No. 2, 392-5(Feb 1972).

In order to elucidate the effect of the crystal structure on the chemical behavior of ^{64}Cu recoil atoms in copper phthalocyanine, the mixed system of copper and metal-free phthalocyanine was studied. It was found that the initial retention increased both in the mixed crystal and in the mixed-disk target. The addition of metal-free phthalocyanine sensitized the target to the thermal annealing reaction, and the rate of the reaction in the mixed crystal was faster than that in the unmixed crystal. The electron acceptor in the target was also found to increase the initial retention. The results were discussed in terms of the electrical properties of the target, which were changed by the change in the spatial arrangement of the molecules. (auth)

25346 EFFECTS OF THE CRYSTAL-STRUCTURAL TRANSFORMATION ON THE CHEMICAL BEHAVIOR OF ^{64}Cu RECOIL ATOMS IN α-COPPER PHTHALOCYANINE. Kudo, Hiroshi (Japan Atomic Energy Research Inst., Tokai). Bull. Chem. Soc. Jap.; 45: No. 2, 389-91(Feb 1972).

The Stage-II annealing process of ^{64}Cu recoil atoms in neutron-irradiated α-copper phthalocyanine was carefully examined. The isothermal annealing curve above 270°C showed an anomalous inflection point. It was found that the Stage-II annealing process of the α-crystal consisted of a "normal" monotonous annealing process and a "delayed" process caused by the crystal-structural transformation. The results of a kinematic analysis suggested that the fluctuation of the matrix and the change in the crystallographic factors due to the structural transformation play a triggering role in the delayed annealing reaction. (auth)

25347 LIMITS OF THE VALIDITY OF THE KINETIC THEORY OF HOT-ATOM REACTIONS. Malcolme-Lawes, D. J. (Yale Univ., New Haven). J. Chem. Phys.; 56: No. 7, 3442-54(1 Apr 1972).

Using a simple stochastic model the kinetic theory of hot-atom reactions was tested under conditions of high reactivity and non-constant α values. The meaning of the derived kinetic parameters and their relation to the corresponding properties of the model are discussed. The kinetic-theory parameters are unreliable if α varies within the hot reaction region. (auth)

Properties of Radioactive Materials

Refer also to abstracts 25203, 25253, 25278–25283, 25947, 25948, 25975, and 27038.

25348 (IJS-P-273) INVESTIGATION OF THE REACTION BETWEEN URANIUM TETRAFLUORIDE AND FLUORINE UNDER PRESSURE. Bohinc, Matej (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Oct 1971. 46p. (In Slovenian). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Ljubljana Univ., Yugoslavia.

Reactions in the system UF_4-F_2 were studied. The reactions were carried out under pressure at 80°C in two steps: $2UF_4 + F_2 \rightarrow 2UF_5$ and $2UF_5 + F_2 \rightarrow 2UF_6$. The effects of fluorine pressure (4 to 11 atm measured at 22°C), specific surface area of uranium tetrafluoride (6 m^2/g and 10 m^2/g), and presence of hydrogen fluoride were investigated for the first reaction. When higher fluorine pressure and/or UF_4 with larger surface area were used,

the reaction rate increased. In such cases about 17 mole % UF_6 was formed besides β-UF_5. The rate of the second reaction is influenced by the presence of UF_6. The reaction rate doubled at the equilibrium vapor pressure of UF_6. The first reaction rate increased in the presence of hydrogen fluoride (UF_4 : HF = 1 : 2) whereas the rate of the second reaction decreased at the same time. In addition, thermal decomposition of XeF_6UF_5 in a dynamic vacuum and in closed system was investigated. The thermal decomposition of the complex at 50 and 60°C in a dynamic vacuum is given by the following equation: $XeF_6UF_5 \rightarrow XeF_6 + \beta - UF_5$, whereas the decomposition in a closed system at 40, 50, 60, and 70°C proceeds as: $2XeF_6UF_5 \rightarrow XeF_6 + XeF_4 + 2UF_6$. The reaction in a dynamic vacuum is zero order. Its activation energy amounted to 30 kcal/mol ±5%. (auth)

25349 ESTIMATED FREE ENERGIES OF FORMATION OF SOME LANTHANIDE AND ACTINIDE HALIDES AT 600° TO 800°C USING MOLTEN SALT–LIQUID METAL DISTRIBUTION COEFFICIENT DATA. Ferris, L. M.; Mailen, J. C.; Smith, F. J. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem.; 34: No. 2, 491-500(Feb 1972).

Distribution coefficient data obtained at 600° to 800°C with lithium halide–Bi and $MgCl_2$–Mg systems were used in conjunction with other necessary thermochemical data to estimate standard free energies of formation (ΔG^f) for several lanthanide and actinide halides. The estimated values of ΔG^f for YCl_3, $LaCl_3$, $CeCl_3$, $ThCl_4$, $ThBr_4$, UBr_3, $NpCl_3$, and PuOCl were in good agreement with those reported in the literature, whereas the ΔG^f values for UCl_3 and $PuCl_3$ generally were slightly less negative than reported. The values obtained for $NdCl_3$, $LaBr_3$, and $NdBr_3$ at 640°C were in disagreement with previous estimates, as was the value of –329 ± 5 kcal/mole obtained for $\Delta G^f_{NpF_3(s)}$ at 600°C. (auth)

25350 PRECIPITATION OF THORIUM, URANIUM(IV), AND PLUTONIUM(IV) OXALATE COMPLEX IONS WITH HEXAUREA CHROMIUM(III) CHLORIDE. Hoshi, Michio; Ueno, Kaoru (Japan Atomic Energy Research Inst., Tokai). J. Inorg. Nucl. Chem.; 34: No. 3, 981-6(Mar 1972).

The precipitation behavior of thorium, uranium(IV), and plutonium(IV) in an ammonium oxalate solution with hexaurea chromium (III) ion was studied. Grayish-green colored precipitate was produced in the case of thorium(IV), and green colored precipitates in the case of uranium(IV) and plutonium(IV). The compositions of the compounds were, $[Cr(CON_2H_4)_6]_2[Th(C_2O_4)_5] \cdot 5H_2O$, $[Cr(CON_2H_4)_6]_2[U(C_2O_4)_5] \cdot 5H_2O$, and $[Cr(CON_2H_4)_6]_4[Pu(C_2O_4)_4]_3 \cdot nH_2O$, respectively. Chemical and crystallographic properties of these compounds were studied. (auth)

25351 TWO NEW ALKALI METAL URANIUM OXIDE FLUORIDES WITH URANIUM IN TWO OXIDATION STATES. Fleckenstein, J.; Kemmler-Sack, S.; Ruedorff, W. (Univ., Tuebingen, Ger.). Z. Naturforsch.; 26b: No. 12, 1367-8(Dec 1971). (In German).

Studies of the system alkali metals–uranium–oxygen–fluorine yielded cubically crystallized compounds for rubidium and cesium. The reaction was performed at 650°C under argon in loosely closed platinum tubes. Reaction times were 6 hours for rubidium preparations and 12 hours for cesium preparations. Optical studies revealed that the two oxide fluorides contained hexavalent as well as tetravalent uranium. Therefore, the compounds must be formulated as $Me_{13}U_4O_9F_{18}$. The two compounds possess a temperature-dependent paramagnetism that does not follow the Curie–Weiss law. (H.B.G.)

25352 RAPID TECHNIQUE FOR DISSOLUTION OF NITRIDES. Bollmann, Dean H. (Albany Metallurgy Research Center, Oreg.). Anal. Chem.; 44: No. 4, 887-8(Apr 1972).

A tin(II)–strong phosphoric acid reagent dissolves TiN, ZrN, HfN, UN, AlN, and niobium oxynitride without loss of nitrogen. VN and BN would not completely decompose. Comparison results with other methods are shown. (M.C.G.)

25353 CITRIC ACID COMPLEXES OF Am(III). Eberle, S. H.; Moattar, F. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). Inorg. Nucl. Chem. Lett.; 8: No. 3, 265-70(Mar 1972). (In German).

A spectrophotometric study was made of complex formation in aqueous solutions between Am(III) and citric acid (and, for comparison, propanetricarboxylic acid) at 25°C and ionic strength of 1, and up to pH ~12. Four displaced absorption bands indicated the formation of four different complexes (one of which was previously unknown), dependent on the hydrogen ion concentration. Based on computer processing of the data relating to the bands observed and the measured extinctions, a progressive complex formation scheme is proposed for the reaction between Am(III) and citric acid over the pH range studied. The stability constants and molar extinction coefficients of the complexes identified are tabulated. (UK)

25354 OSCILLOPOLAROGRAPHIC REDUCTION OF URANYL IONS AT A MERCURY ELECTRODE IN ACIDIC NITRATE MEDIA. Casadio, S.; Orlandini, F. (CNEN–CSN, Casaccia, Italy). Electrochim. Acta; 17: No. 3, 441-4(Mar 1972).

In highly concentrated nitrate salt solutions, when the H^+ activity causes high kinetic currents, the uranyl detection by oscillopolarography is displayed by the occurring of an ECE-1 mechanism rather than disproportionation of U(V) species. The relative kinetic parameter is evaluated for the 4 M nitrate concentration. (auth)

25355 NEW THEORETICAL AND SPECTRAL STUDIES OF URANIUM(V) COMPOUNDS. Selbin, J.; Ballhausen, C. J.; Durrett, D. G. (Louisiana State Univ., Baton Rouge). Inorg. Chem.; 11: No. 3, 510-15(Mar 1972).

The theory of 5f systems was extended from O_h symmetry species, such as UX_6^-, to "tetragonally" distorted, more recently prepared species, UOX_5^{2-} (X^- = F^-, Cl^-, Br^-). The semiempirical calculation was carried out specifically for $UOCl_5^{2-}$, by beginning with the $5f^1$ energy levels of U^{5+} (in UCl_6^-) split by the O_h crystal field and by by the spin–orbit coupling and perturbed by the effects of the lower symmetry field. The results (using the O_h notation) are that (1) the $\Gamma_7 \rightarrow \Gamma_7'$ transition is left nearly unaltered, (2) the Γ_8 and Γ_8' quadruplet levels are significantly split, (3) the Γ_8 level leads to a very low-lying electronic band, (4) the Γ_8 energy is greatly increased, and (5) the average g value is left relatively unchanged. A careful study of the spectrum of $UOCl_5^{2-}$ in the 300 to 25,000-cm^{-1} range and of the ESR spectrum has demonstrated the accuracy of these predictions. New complexes of the UO^{3+} entity are reported. (auth)

25356 TRANSFORMATIONS IN THE URANIUM FORMATE SERIES. Navarro, A. (Institut National des Sciences Appliquees, Villeurbanne, France). Ann. Chim. (Paris); 6: No. 5, 349-58(Sep 1971). (In French).

U(IV) tetraformate ($U(HCOO)_4$) was prepared by a new method involving the electrochemical reduction of a uranyl diformate solution ($UO_2(HCOO)_2 \cdot H_2O$). The U(IV) tetraformate presents at least three polymorphic forms: α, β, and γ. The different stages of the evolution of α–$U(HCOO)_4$ and $UO_2(HCOO)_2 \cdot H_2O$ when in heterogeneous reaction with oxygen, water, or an oxygen–water mixture were demonstrated. Investigations of the heterogenous reactions enabled the various intermediate reactions which take place during the process to be established. The mass balances were determined, and a transformation scheme for the different uranium formates was established. All the compounds are characterized by chemical analysis, x-ray diffraction, and π spectrophotometry. The results obtained facilitate the study of the complex mechanisms of these heterogeneous reactions. (France)

25357 SYNTHETIC INORGANIC ION-EXCHANGERS. I. HYDROUS OXIDES AND ACIDIC SALTS OF MULTIVALENT METALS. Vesely, V.; Pekarek, V. (Nuclear Research Inst., Prague). Talanta; 19: No. 3, 219-62(Mar 1972).

An exhaustive literature survey is given of the hydrous oxides and acidic salts of multivalent metals that are used as ion-exchange materials, the survey covering the preparation, properties, uses and theory of these materials. The materials include compounds of Th and Zr. (466 references) (auth)

25358 SOLVOLYSIS OF ORGANIC PHOSPHATES. V. PARTICIPATION OF THE NEIGHBORING GROUPS AND EFFECTS OF METAL IONS IN THE HYDROLYSIS OF 3-HYDROXY-2-PYRIDYLMETHYL PHOSPHATE. Murakami, Yukito; Sunamoto, Junzo; Ishizu, Hideyuki (Kyushu Univ., Fukuoka). Bull. Chem. Soc. Jap.; 45: No. 2, 590-9(Feb 1972).

The spontaneous hydrolysis of 3-hydroxy-2-pyridylmethyl phosphate was investigated at 60, 70, and 80°C over the $-\log[H^+]$ range from 1 to 10 in aqueous media with an ionic strength of 0.10. The reactions followed apparent first-order kinetics with respect to the unreacted phosphate species, and the maximum rate was observed at $-\log[H^+]$ 7 to 8. Reactive species in hydrolysis were neutral zwitterion, monoanion, and dianion species, the reactivity increasing in this order. This trend in reactivity order has not been observed previously. In a moderately acidic region ($-\log[H^+] < 2.0$), kinetic data were consistent with the acid catalysis acting on the zwitterion species. Activation parameters provide an evidence for the unimolecular nature of the transition state in spontaneous hydrolysis and suggest the Al process for the acid catalyzed reaction. The anomalously high reactivity of the dianion species was attributed to participation of the 3-hydroxy group in the reaction process: intramolecular transfer of the hydroxyl proton to the ester oxygen in a pre-equilibrium stage, followed by the P–O bond cleavage in the subsequent transition state to give the products. Hydrolysis was also carried out in the presence of copper(II), nickel(II), zinc(II), aluminum(III), iron(III),

and thorium(IV) ions at 60°C and $\mu = 0.10$ in a relatively lower pH range. Introduction of the 3-hydroxyl group to 2-pyridylmethyl phosphate resulted in a change of catalytic status of various metal ions. Only iron(III) and thorium(IV) ions accelerated the rate to a significant extent. Validity of the two requirements originally proposed for the bivalent metal catalysis was extended to the polyvalent metal catalysis. (auth)

25359 THERMODYNAMIC CONSIDERATIONS ON THE FORMATION OF COMPLEX IONS IN FUSED SALTS OF $ThCl_4$–NaCl SYSTEMS. Oyamada, Ryozo (National Research Inst. for Metals, Tokyo). J. Phys. Soc. Jap.; 32: No. 4, 1044-8(Apr 1972). (In German).

The electromotive force and its temperature-dependence of fused salts of the $ThCl_4$–NaCl system were measured with a $Th(s)/ThCl_4$–$NaCl(l)/Cl_2(g)$ cell using highly purified $ThCl_4$($ThCl_4$ 0.22 to 0.70 mole fraction, 600 to 750°C). To discuss the formation and existence of complex ion in the melts, the equation of excess stability $dF_i^E/d(1 - N_i)^2$, where N_i is the mole fraction of $ThCl_4$ and P_i^E the excess partial molar free energy of $ThCl_4$, derived by Darken was adopted. Curves of the excess stability plotted against N_i show a maximum at around $N_i = 0.35$ corresponding to the congruently melting compound Na_2ThCl_6. Meanwhile, plots of the equivalent conductivity and the isotherms, calculated from the previously reported values against N_i revealed a large negative deviation from the additivity at $N_i = 0.33$(550 to 750°C). From both these results the existence of the anionic complex ion $[ThCl_6]^{2-}$ in the fused state was inferred. (auth)

25360 METAL COMPLEXES OF N-HYDROXYETHYL-NAPHTHALIDENEIMINE SCHIFF BASE. Mehta, R. K.; Singhi, V. C. (Univ. of Jodhpur, India). Z. Naturforsch.; 27b: No. 3, 304-7(Mar 1972).

The Schiff base, N-hydroxyethylnaphthalideneimine, forms solid complexes with Mn(II), Co(II), Ni(II), Cu(II), Zn(II), Cd(II), Pd(II), and UO_2(II). The structures of these compounds are discussed on the basis of their elemental analysis, magnetic moment values, and electronic spectral data. These studies proved conclusively that UO_2(II) and Mn(II) complexes are octahedral in shape whereas the Cu(II) complex molecule displays a square planar or tetragonally distorted octahedral configuration. Co(II), Ni(II), Zn(II), and Cd(II) complexes are tetrahedral in structure while the Pd(II) compound is square planar. (auth)

25361 STUDY OF OXIDATION STATE OF PLUTONIUM IN SOLUTION BY FLOW-COULOMETRIC METHOD. Kihara, Sorin (Japan Atomic Energy Research Inst., Tokai); Yamamoto, Tadashi; Motojima, Kenji; Fujinaga, Taitiro. Talanta; 19: No. 3, 329-40(Mar 1972).

Reduction rates of Pu(IV) and oxidation rates of Pu(III) were studied in sulphuric acid and nitric acid media, as functions of acid concentration, plutonium concentration and kind of acid. A flow-coulometric method was used in this work. This procedure has many merits, namely, the sample size required is very small, special reagents are not used, fewer limitations are imposed by the type and concentration of acid, and the method is rapid. (auth)

25362 PREPARATION OF ^{18}F LABELLED p-FLUOROPHENYLALANINE FOR CLINICAL USE. Goulding, R. W.; Palmer, A. J. (Hammersmith Hospital, London). Int. J. Appl. Radiat. Isotop.; 23: No. 3, 133-7(Mar 1972).

A method is described for the preparation and analysis of fluorine-18-labelled p-fluorophenylalanine, starting from fluorine-18 produced by the cyclotron bombardment of water with 30-MeV α particles. The procedure is more convenient than methods hitherto published and has yielded material of sufficiently high specific activity to enable clinical trials to be carried out to assess its potential use as a pancreas scanning agent. (auth)

25363 FLUORESCENCE SPECTRUM AND RELAXATION TIME MEASUREMENT OF $Cs_2UO_2Br_4$. Wong, Dorothy Pan (California State Coll, Fullerton); Wong, Andrew Y. C.; Wong, Eugene Y. J. Chem. Phys.; 56: No. 6, 2838-43(15 Mar 1972).

Fluorescence spectra of $Cs_2UO_2Br_4$ were studied at 14, 4.2, and 1.4°K. Raman spectrum and relaxation times were also measured. At low temperatures, the fluorescence spectra showed additional lines that had highly temperature-dependent relative intensities. These lines are thought of as originating from dislocations of the uranyl complex. The problem of parity of the first excited electronic state of the uranyl ion is also discussed. (auth)

25364 CRYSTAL STRUCTURE OF $RbTh_3F_{13}$. Brunton, George (Oak Ridge National Lab., Tenn.). Acta Crystallogr., Sect. B; 27: 1823-6(1971).

The complex fluoride $RbTh_3F_{13}$ crystallizes with space group $P2_1ma$; $a_0 = 8.6490$ (5), $b_0 = 8.176$ (2) and $c_0 = 7.4453$ (4) Å. There are two formula weights per unit cell and the calculated density is 6.488 g.cm^{-3}. There are two thorium ions in the asymmetrical unit and each of these ions has nine nearest neighbor fluorine ions at the corners of capped trigonal prisms. The Th–F distances range from 2.32 (3) to 2.48 (2) Å. The Rb ion has eleven nearest neighbor fluorine ions in the range 2.79 (3) to 3.37 (2) Å. The final discrepancy index is 0.0710 for 2134 Ag Kα reflections >σ. (auth)

25365 CRYSTAL STRUCTURE OF α-KTh_6F_{25}, A POLYMORPH OF CsU_6F_{25}. Brunton, George (Oak Ridge National Lab., Tenn.). Acta Crystallogr., Sect. B; 28: 144-7(1972).

Crystals of α-KTh_6F_{25} are hexagonal-rhombohedral, $R\bar{3}m$, with hexagonal axes $a_0 = 8.313$ (2), $c_0 = 25.262$ (4) Å, $Z = 3$ and ρ(cal) = 6.281 g.cm^{-3}. Structural units of α-KTh_6F_{25} are identical to those of CsU_6F_{25} and comprise two adjacent rings of Th^{4+}–F polyhedra, 6 polyhedra, 6 polyhedra per ring, with an alkali metal ion centered between the rings. The structural units are stacked ABCABC along c_0 in α-KTh_6F_{25} and ABAB in CsU_6F_{25}. K–F distances are 3.19 (2) and 3.20 (3) Å. Th–F distances range from 2.308 (1) to 2.541 (9) Å. (auth)

25366 THERMODYNAMICS OF METAL COMPLEX FORMATION IN AQUEOUS SOLUTION. I. A POTENTIOMETRIC STUDY OF FLUORIDE COMPLEXES OF HYDROGEN, URANIUM (VI), AND VANADIUM(IV). Ahrland, Sten; Kullberg, Lennart (Univ. of Lund, Sweden). Acta Chem. Scand.; 25: No. 9, 3457-70 (1971).

The formation of fluoride complexes of hydrogen, uranyl(VI), and vanadyl(IV) ions was studied in an aqueous medium of unit ionic strength with sodium perchlorate as supplementary electrolyte, at 25.0°C. Two methods, both potentiometric, were used, viz. acidity measurements by the quinhydrone electrode and direct measurements of the concentrations of free fluoride ions by the fluoride membrane electrode (FME). The systems are all mononuclear. The stability constants for the complexes were evaluated both graphically and by a computer method. The values found are more precise than any determined before for these systems. Within the limits of error, however, they agree quite well with those determined previously under the same conditions. (auth)

25367 THERMODYNAMICS OF METAL COMPLEX FORMATION IN AQUEOUS SOLUTION. II. A CALORIMETRIC STUDY OF FLUORIDE COMPLEXES OF HYDROGEN, URANIUM (VI), AND VANADIUM(IV). Ahrland, Sten; Kullberg, Lennart (Univ. of Lund, Sweden). Acta Chem. Scand.; 25: No. 9, 3471-83(1971).

The enthalpy changes for the formation of hydrogen, uranyl(VI), and vanadyl(IV) fluoride complexes were determined by a direct calorimetric titration procedure. From these enthalpy changes and the changes in free energy computed from the corresponding stability constants the entropy changes were calculated from the relationship: $\Delta G_j^0 = \Delta H_j^0 - T\Delta S_j^0$. All data refer to 25.00°C and an aqueous sodium perchlorate medium of ionic strength 1.00M. In the fluoride systems studied, nearly all the species are formed in endothermic reactions. The strong complex formation for these systems thus depends upon the large gains of entropy involved. (auth)

25368 THERMODYNAMICS OF METAL COMPLEX FORMATION IN AQUEOUS SOLUTION. III. A CALORIMETRIC STUDY OF HYDROGEN SULPHATE AND URANIUM(VI) SULPHATE, ACETATE, AND THIOCYANATE COMPLEXES. Ahrland, Sten; Kullberg, Lennart (Univ. of Lund, Sweden). Acta Chem. Scand.; 25: No. 10, 3677-91(1971).

The enthalpy changes for the formation of sulfate, acetate, and thiocyanate complexes of uranyl(VI) ions in an aqueous perchlorate medium of ionic strength 1.00M were determined calorimetrically at 25.00°C. By the same method, both the stability constant and the enthalpy change for the formation of hydrogen sulfate were also determined. From the changes of enthalpy thus found, and the changes of free energy computed from the known stability constants, the changes of entropy were calculated. (auth)

25369 SUGGESTION FOR THE DETERMINATION OF PLUTONIUM VALENCIES IN AQUEOUS SOLUTIONS. Silver, G. L. (Mound Lab., Miamisburg, Ohio). Contract AT-33-1-Gen-53. Radiochem. Radioanal. Lett.; 9: No. 5-6, 315-20(31 Mar 1972).

An equation was derived that may be useful in the determination of plutonium oxidation state concentrations in aqueous solutions. (auth)

25370 STRUCTURE OF HYDROGEN TRIURANATE. Siegel, Stanley; Viste, Arlen; Hoekstra, Henry R.; Tani, Benjamin (Argonne National Lab., Ill.). Acta Crystallogr., Sect. B; 28: 117-21 (1972).

Hydrogen triuranate, $H_2U_3O_{10}$, is triclinic, space group $P\bar{1}$, with $a = 6.802$ (5), $b = 7.417$ (16), $c = 5.556$ (5) Å, $\alpha = 108.5$ (4), $\beta = 125.5$ (1), and $\gamma = 88.2$ (2)°. Measured density is 6.7 g cm^{-3} and

the computed value is 6.85 g cm^{-3} for the one formula weight. The structure was resolved with 756 independent reflections recorded with an automatic diffractometer utilizing the double-filter technique. A least-squares refinement, based on F, gave an R value of 6.0%. The configuration of oxygen atoms about U(1) (at origin) is an octahedron, while the coordination about U(2) (in general positions) is a pentagonal bipyramid. Apex oxygen atoms lead to shared U(2)–U(1)–U(2′) bipyramids and octahedra to give triuranate groups along c*. The apex (uranyl) oxygen atoms of each bipyramid form part of an octahedral array of oxygen atoms about the point 0 ½ 0 of the unit cell as a "center." The hydrogen atoms can be shown to be associated with oxygen atoms of this octahedron. (auth)

25371 CHEMICAL METHODS FOR REMOVING RADON AND RADON DAUGHTERS FROM AIR. Stein, Lawrence (Argonne National Lab., Ill.). Science; 175: No. 4029, 1463-5(31 Mar 1972).

Liquid bromine trifluoride and the solid complexes ClF_2SbF_6, BrF_2SbF_6, $BrF_4Sb_2F_{11}$, $IF_4(SbF_6)_3$, and BrF_2BiF_6 react spontaneously with radon and radon daughters at 25°C, converting the radioelements to nonvolatile ions and compounds. The reagents can be used in gas-scrubbing units to remove radon and radon daughters from air. The halogen fluoride–antimony pentafluoride complexes may be suitable for purifying air in uranium mines and analyzing radon in air, since they have low dissociation pressures at 25°C and are less hazardous to handle than liquid halogen fluorides. (auth)

25372 PROCEEDINGS OF THE 6th RADIOCHEMICAL CONFERENCE ON THE METHODS OF PREPARATION, STORAGE, AND CONTROL OF LABELED COMPOUNDS, MARIANSKE LAZNE, CZECHOSLOVAKIA, MAY 3–8, 1971. PART 1. Radioisotopy; 12: No. 4, 491-696(1971). (CONF-710538–(Pt.1)).

Sixteen papers are included in Volume I. Separate abstracts were prepared for 5 papers. (M.C.G.)

For abstracts of individual papers see: 25278–25280, 25373, and 25390.

25373 DEVICE FOR THE SAFE HANDLING OF TRITIUM GAS. den Hollander, W. (Vrije Univ., Amsterdam). Radioisotopy; 12: No. 4, 589-94(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

A description is given of a device for tritium handling that has the following three distinct advantages: Tritium gas is stored as uranium tritide behind a palladium diffusion tube in a totally sealed vessel. The palladium tube insures the chemical purity of the tritium gas. A special designed gas burette is connected to the storage vessel. The amounts of gas can be determined before and after use. Tritium gas is transported from gas burette to reaction vessel and vice versa with the aid of a Toepler pump. The tritium gas in the reaction vessel can be pressurized up to 3 atmospheres. (auth)

25374 PROCEEDINGS OF THE 6th RADIOCHEMICAL CONFERENCE ON THE METHODS OF PREPARATION, STORAGE, AND CONTROL OF LABELED COMPOUNDS, MARIANSKE LAZNE, CZECHOSLOVAKIA, MAY 3–8, 1971. PART 2. Radioisotopy; 12: No. 5, 699-882(1971). (CONF-710538–(Pt.2)).

Sixteen papers are included in Volume II. Separate abstracts were prepared for seven papers. (M.C.G.)

For abstracts of individual papers see: 25194–25198, 25281, and 25375.

25375 STABILITY OF SOME IODOORGANIC COMPOUNDS LABELED WITH ^{131}I. Lisewska, I.; Pasternak, A.; Proszynska, K. (Inst. of Nuclear Research, Swierk, Poland). Radioisotopy; 12: No. 5, 725-35(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

Methods were investigated for elimination of the changes caused by the self-radiation effects in some radiopharmaceuticals labeled with ^{131}I. Investigations of the self-decomposition process that occurs in samples stored parallely at room temperature and the temperature of dry ice (about –70°C) were performed. Investigations on o-iodohippurate-^{131}I and Rose Bengal-^{131}I are described. The results obtained for the self-decomposition degree of o-iodohippurate-^{131}I are in some region of concentration consistent with the published data. In all cases the lowering of the storage temperature increased the stability of the compounds. The increase of inorganic iodine did not exceed about 1% when stored for more than 20 days (o-iodohippurate-^{131}I) or more than 40 days (Rose Bengal-^{131}I). Short-time defrosting of the samples did not lower the stability of the compounds. (auth)

25376 PROCEEDINGS OF THE 6th RADIOCHEMICAL CONFERENCE ON THE METHODS OF PREPARATION, STORAGE, AND CONTROL OF LABELED COMPOUNDS, MARIANSKE LAZNE, CZECHOSLOVAKIA, MAY 3–8, 1971. PART 3. Radioisotopy; 12: No. 6, 883-1056(1971). (CONF-710538–(Pt.3)).

Fifteen papers are included in Volume III. Separate abstracts were prepared for 4 papers. (M.C.G.)

For abstracts of individual papers see: 25282, 25283, 25377, and 25378.

25377 SELF-DECOMPOSITION OF ^3H-THYMIDINE STORED IN A PHOSPHATE BUFFER. Apelgot, S.; Frilley, M. (Institut du Radium, Paris). Radioisotopy; 12: No. 6, 893-914(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

Radiolysis and self-decomposition of ^3H-thymidine at different concentrations were compared in aqueous solutions and in a phosphate buffer. The results obtained in frozen solutions show that, whereas phosphate buffer is a sensitizer in radiolysis, it is a protector against self-decomposition when the concentration of ^3H-thymidine is greater than 0.5×10^{-3} M. With time, the amount of self-decomposition reaches a limit. Thus the buffer seems suitable for storing water-soluble tritiated compounds. (auth)

25378 STUDY ON AUTORADIOLYSIS OF TRITIATED NUCLEOSIDES. Kopoldova, J.; Dedkova, V. (Inst. for Biological Research, Prague). Radioisotopy; 12: No. 6, 915-27(1971).

From 6. radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

Autoradiolytic decomposition of thymidine-[6-T] and uridine-[5-T] in aqueous solution at +2 and +15°C in ethanol and on chromatographic paper was studied in relation to time of storing and specific activity. (auth)

25379 THERMAL DECOMPOSITION OF SULPHAMIC ACID AND URANYL SULPHAMATE. Sampath, S.; Aravamudan, G. (Indian Inst. of Tech., Madras). Indian J. Chem.; 9: No.11, 1282-5(Nov 1971).

Thermal decomposition of sulfamic acid in humid atmosphere proceeds via the intermediate formation of ammonium pyrosulphate, $(NH_4)_2S_2O_7$, as a result of adsorption of water from the atmosphere by sulfamic acid. The formation of the double salt, $(NH_4)_2UO_2(SO_4)_2$, during thermal decomposition of uranyl sulfamate, $UO_2(NH_2SO_3)_2 \cdot 4 \cdot 5H_2O$, was also found to proceed by a similar process. That the double salt is formed as a result of isomerization of the intermediate $UO_2(NH_2SO_3)_2 \cdot 2H_2O$, as proposed by Capestan [Ann. Chim., 5 (1960), 222], is not supported by the results of the present study. (auth)

Radioactive Waste Treatment

25380 (BARC–563) TRANSFORMATION OF INDIAN BENTONITES AND TIIEIR UTILISATION IN RADIOACTIVE WASTE TREATMENT. Brat, Satya; Balu, K. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 22p. Dep. NTIS (U. S. Sales Only).

Three Indian bentonites, viz., Bihar bentonite, Rajasthan bentonite, and Saurashtra bentonite were transformed by continuously boiling them with 1 M $Mg(CH_3COO)_2$ in pyrex flasks at atmospheric pressure and boiling solution temperature for a period of 45 days. The products obtained were studied for their mineralogical and sorptive properties, and for their use in the treatment of radioactive liquid wastes containing Cs^+, Mn^{++}, and Sr^{++} ions. (auth)

25381 METHOD OF DISSOLVING RADIOACTIVE CONTAMINATED ORGANIC ION EXCHANGE RESINS. Wilding, Malcolm W. (to United States Atomic Energy Commission). U. S. Patent 3,629,135. 21 Dec 1971. Filed 10 Oct 1968.

Radioactive-contaminated organic ion-exchange resin can be completely dissolved for disposal by heating at 70 to 90°C in a 1 to 2 M HNO_3 solution containing $KMnO_4$. (B.L.M.)

Radioisotope Production

Refer also to abstracts 25161 and 26097.

25382 (AAEC/E–224) ^{99m}Tc GENERATORS PREPARED FROM FISSION PRODUCED ^{99}Mo: QUALITY CONTROL AND PERFORMANCE ASPECTS. Boyd, R. E.; Hetherington, E. L. R.; Wood, N. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1971. 27p. Dep. NTIS (U. S. Sales Only).

The production of ^{99m}Tc generators and the methods employed in their testing are described. The quantity of ^{99m}Tc eluted from generators based on ^{99}Mo extracted from irradiated uranium varied with pH of the eluant with maxima at pH 0.5 to 0.9, 3, 4.7 to 6.7 and >9.5. Terminal autoclaving reduced the yield by 10 to 20%. An ionization chamber method and a γ-spectrometry method

were developed to measure the radionuclidic purity of eluates. Impurity levels were lower than the minimum permitted concentrations set by the USAEC. The major impurities, ^{99}Mo, ^{132}I, and ^{103}Ru can be reduced to insignificant levels by discarding the first few ml of eluate at each elution. Soluble aluminum concentration in the eluate decreased exponentially with eluant volume. In most cases it was less than 5 μg/ml after 100 ml had been passed through the generator. Stringent quality control procedures ensured a sterile and pyrogen-free product. The results of this study confirm the value of the fission-based ^{99m}Tc generator and remove any existing obstacles to its wider exploitation. (auth)

25383 PRODUCTION OF HIGH-PURITY ^{137}Cs. Rupp, Arthur F.; Pinajian, John J.; Rimshaw, Stanley J. (to United States Atomic Energy Commission). U. S. Patent 3,635,831. 18 Jan 1972. Filed 25 Sep 1969.

A method was provided for the production of high-purity ^{137}Cs free of ^{134}Cs. Concentrated ^{137}Cs free of ^{134}Cs is obtained by removing nonsoluble gases, including xenon isotopes, from an operating reactor and passing these gases through a stainless steel mesh at a point in time of the gas removal path to optimize the decay of ^{137}Xe to ^{137}Cs. Since cesium is highly reactive, it will react with the mesh and thereby be deposited thereon. The mesh is then periodically removed from the gas stream and washed with water to remove the solids enriched in ^{137}Cs. (auth)

25384 PLANT PRACTICE IN SOLVENT EXTRACTION PROCESSING OF ALPHA-EMITTING NUCLIDES OF HIGH SPECIFIC ACTIVITY. Bigelow, J. E.; Chattin, F. R.; Vaughen, V. C. A. (Oak Ridge National Lab., Tenn.). pp 507-13 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

In the Transuranium Processing Plant at Oak Ridge National Laboratory, three solvent extraction processes are used (Pubex, Tramex, and Cleanex) on the scale of up to 100 l to recover transuranium elements from irradiated target assemblies. The Pubex and Cleanex processes use an acidic phosphate ester as extractive reagent in diethylbenzene or kerosene diluent. The Tramex process uses a straight-chain tertiary amine in diethylbenzene as extractant. Process solutions frequently have radiation power densities of 5 to 30 W/l, owing to the presence of ^{244}Cm. Few problems have arisen from radiation effects at this level while processing in nitric acid solutions. However, in hydrochloric acid solutions radiolysis of the solution results in the loss of acid and the production of strong oxidizing species, both effects requiring careful control to maintain proper operation of the processes at these radiation power densities. In addition, the presence of common chemical contaminants in process streams frequently causes difficulties as severe as those produced by radiation effects. The necessity of identifying and controlling the sources of these contaminants is a typical task encountered in the scale-up from the laboratory to the plant. 14 references (auth)

25385 ISOLATION OF TRANSPLUTONIUM ELEMENTS. Orth, D. A.; McKibben, J. M.; Prout, W. E.; Scotten, W. C. (E. I. du Pont de Nemours and Co., Aiken, S. C.). pp 534-55 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The programme for the production of transplutonium elements at the Savannah River Plant is described, together with associated laboratory studies, under the following headings: introduction; plant processing—Cm plant (process descriptions; materials accounting; radiation effects); laboratory work on transplutonium extraction (solvent extraction as pretreatment for ion exchange; work for Cm plant); studies on lanthanide—actinide separations (acidity effects; temperature effects; TBP concentration; nitric acid distribution; salt—diethylenetriaminepentacetic acid systems; control of pH; flowsheet calculations; computer codes; and stabilities of existing operations). 12 references. (UK)

25386 PROCESS FOR THE EXTRACTION OF ^{238}Pu FROM A NEPTUNIUM SOLUTION CIRCULATING THROUGH A REACTOR. Hynes, C. J.; Jenkins, I. L.; Wain, A. G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 801-14 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The advantages of making ^{238}Pu by irradiating an aqueous solution of neptunium(V) nitrate in a reactor loop are discussed, and a process for the rapid separation of ^{238}Pu is described. The plutonium can be extracted efficiently into a dilute solution of a tertiary amine in a diluent, leaving the neptunium and the fission products in the aqueous phase, which can be recycled through the reactor. 17 references (auth)

25387 PRODUCTION OF ^{231}Pa AND ^{232}U BY REACTOR NEUTRON IRRADIATION OF ^{230}Th AND ^{232}Th MIXTURE. Kim, J. I.; Born, H.-J. (Technische Univ., Munich). Radiochim. Acta; 16: No. 3-4, 160-72(Dec 1971).

A study was made to prove and elaborate the conditions of production of ^{231}Pa and ^{232}U by reactor neutron irradiation of ^{230}Th mixed with ^{232}Th as a starting material. The build-up characteristics of all transmuted nuclides from either target nuclide and also from the ^{231}Pa as an intermediate target are systematically demonstrated with respect to the neutron flux, the epithermal index, and the irradiation time. By thorough evaluation of all factors associated in the multiple transmutation reactions, it appears possible to establish the production scheme to increase the production yields of ^{231}Pa and ^{232}U several folds higher than the values estimated by previous authors. The chemical separation methods used exclusively are the anion exchanges in the mixed solutions of mineral acids and organic solvents, which have shown the advantages of the selective separations and of handling protactinium ions in a stable form. (auth)

25388 CYCLOTRON PRODUCED ^{111}In FOR MEDICAL USE. Thakur, M. L.; Nun, A. D. (Medical Research Council, Hammersmith, Eng.). Int. J. Appl. Radiat. Isotop.; 23: No. 3, 139-40 (Mar 1972).

A method is briefly described for the production of ^{111}In by α particle bombardment of a target composed of 0.05-mm-thick natural silver, plated on 0.012-mm rhodium, plated on copper target plates in normal use. The use of the Rh interlayer resulted in its being possible to use a simple ion exchange method of isolating the ^{111}In. A table is presented showing the calculated thick target yield of ^{111}In to be expected from cyclotrons of different maximum alpha particle energies over the range 16 to 30 MeV. (UK)

25389 SELECTIVE SEPARATION OF ^{99}Mo FROM FISSION PRODUCTS IN CHLORIDE MEDIA ON ACTIVATED ALUMINA. El-Garhy, M.; Shehata, M. K. K.; El-Bayoumy, S. (Atomic Energy Establishment, Cairo). J. Radioanal. Chem.; 10: No. 1, 35-40(Feb 1972).

The radioisotope ^{99}Mo generated through the fission of neutron-irradiated uranium targets was separated in an extremely radiochemically pure state. The target dissolution mixture was run on a silica gel column whereby the $^{95}Zr-^{95}Nb$ activity, the serious radiocontaminants of ^{99}Mo, was adsorbed on the gel. The effluent from the gel column was processed and treated with sodium dihydrogen phosphate. The processed solution was run on an activated alumina column whereby ^{99}Mo was adsorbed as phosphomolybdate complex ion, then desorbed from the column as the molybdate ion by eluting with 10% NaOH solution. By recycling the adsorption and desorption steps on alumina, ^{99}Mo was finally obtained totally free from all other radiocontaminants. (auth)

25390 PREPARATION OF ORGANIC RADIOPHARMACEUTICALS CONTAINING ISOTOPES OF SHORT HALF-LIFE. Wolf, A. P. (Brookhaven National Lab., Upton, N. Y.). Radioisotopy; 12: No. 4, 499-518(1971).

From sixth radiochemical conference; Marianske Lazne, Czechoslovakia (May 1971).

The advent of the medical cyclotron made a broad spectrum of isotopes of short half-life available for the preparation of radiopharmaceuticals. The problem of time available for synthesis is crucial for utilizing isotopes such as carbon-11, nitrogen-15, fluorine-18, and iodine-123. Methods and technology for preparing and using these isotopes are discussed. The approach involves the use of the accelerator to produce the isotope in its elemental form or in a chemical form (recoil synthesis) suitable for direct use as a precursor in a specific chemical synthesis or in the rapid preparation of simple organic compounds to be used as starting materials in a synthesis. Direct recoil synthesis of the desired compound is also considered. Biosynthetic and enzymatic methods of synthesis from simple labeled precursors are also described. In general a goal of two to eight half-lives is set as the maximum time (measured from t_0 = time at which the accelerator production of the isotope is ended) for synthesis and purification of the desired organic compound. The isotopes carbon-11, fluorine-18, and iodine-123 are specifically described. Preparation of compounds such as dopamine-^{11}C, glucose-^{11}C, o-, m-, and p-fluorophenylalanine-^{18}F, 6-fluorotryptophane-^{18}F, and iophenoxis acid-^{123}I are discussed. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 25556 and 25558.

25391 (ARH-2276) CONTROLLED NITRIC ACID DISSOLUTION OF ALUMINUM-PLUTONIUM ALLOYS. Schulz, Wallace W. (Atlantic Richfield Hanford Co., Richland, Wash.). Feb 1972. Contract AT(45-1)-2130. 13p. Dep. NTIS.

Small concentrations of $Ni(NO_3)_2$ inhibit dissolution of Al-Pu alloys in HNO_3-$Hg(NO_3)_2$ solutions. Utilizing this property, a satisfactory flowsheet for controlled dissolution of Plutonium Recycle Test Reactor Al-Pu alloys in Hanford Purex plant dissolvers was devised and demonstrated. (auth)

25392 (CEA-R-4245) SIMULATION, REGULATION, AND OPTIMIZATION OF THE DYNAMICS OF A MIXER-DECANTER BANK BY A HYBRID (ANALOGUE-DIGITAL) METHOD. Chazal, Guy (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec 1971. 150p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Bordeaux Univ. (France). Faculte des Sciences.

The dynamics, regulation, and static optimization of a mixer-decanter bank were studied by means of an E.A.I. 8900 hybrid computer. The model adopted has 14 stages inside which two phases, aqueous and organic, containing acid, uranium and plutonium, flow countercurrent. The phenomenon is represented by 172 equations, 86 differential and 86 algebraic or transcendental. A hybrid program is proposed with the analog part grouping about 200 amplifiers and 14 multipliers and the digital part corresponding to about 4,000 perforated cards. The analog and digital programs are connected by 19 analog-digital and 19 digital-analog conversion channels. The second part concerns automation after studying the behavior of the bank for certain typical perturbations on the input variables, such as flowrates and concentrations, it was possible to foresee a quasi-optimum regulation where irregular perturbations of which the process is the center were taken into account. Optimum permanent running conditions were determined. (auth)

25393 (DOCKET-50201-113) WEST VALLEY REPROCESSING PLANT. Low Level Waste Treatment Facility, Summary Report No. 4. (Nuclear Fuel Services, Inc., West Valley, N. Y.). 14 Mar 1972. 18p. Dep. NTIS.

The latest plant performance is summarized and the current status of the development program is discussed. Average ^{137}Cs and ^{90}Sr removal was down. This reflects the higher number of activity spikes at resin breakthrough. Plant and process modifications, chemical composition of the feed, cesium adsorbents, resin capacity tests, and chelating agent studies are discussed. (M.C.G.)

25394 (DOCKET-50201-115) WEST VALLEY REPROCESSING PLANT. Supplementary Safety Analysis Plutonium Purification Modifications. (Nuclear Fuel Services, Inc., Rockville, Md.). 11 Apr 1972. 148p. Dep. NTIS.

A summary of the quality assurance program for new construction and plant modifications is presented. Engineering flow diagrams are included for the chemical feed and extraction of the second plutonium cycle, plutonium product evaporation, plutonium product storage and measuring, plutonium waste collection, plutonium product filling, and solvent wash system. Changes to be made in the November 5, 1971, Safety Analysis are listed. (M.C.G.)

25395 (DOCKET-50201-116) WEST VALLEY REPROCESSING PLANT. Technical Specifications , Change 17. (Division of Materials Licensing (AEC), Washington, D. C.). 12 Apr 1972. 5p. Dep. NTIS.

The change is an authorization to change the quantities of radioisotopes necessary for the West Valley laboratories to support the development of the low-level waste treatment plant and the expansion of its environmental monitoring program. (M.C.G.)

25396 (DOCKET-50268-25) MIDWEST FUEL RECOVERY PLANT. Final Safety Analysis Report, Amendment 24. (General Electric Co., San Jose, Calif. Nuclear Fuel Dept.). 14 Mar 1972. 20p. (NEDO-10178-11). Dep. NTIS.

Topics discussed include: potential damage to waste container caused by swelling of calcine waste, reevaluation of tornado missile analysis for waste containers, analysis of postulated drop of waste container, procedures for detecting and handling a leaking waste container, effects of welding and stress concentration on reinforcing rods, and double independent control criterion for H/U ratio in fluorine reactor. (M.C.G.)

25397 (DOCKET-50268-27) MIDWEST FUEL RECOVERY PLANT. Order Extending Provisional Construction Permit Completion Date. (Division of Materials Licensing (AEC), Washington, D. C.). 28 Mar 1972. 2p. Dep. NTIS.

25398 (RT/CHI-(71)14) ANALYTICAL METHODS USED FOR THE VERIFICATION OF IMPURITIES AND STABILITY OF THE TERTIARY AMINE IN THE EUREX PROCESS. Gasparini, G. M.; Pizzichini, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 28 Sep 1971. 33p. (In Italian). Dep. NTIS (U. S. Sales Only).

The degradation and purity control of Alanine 336, an amine mixture employed as extractant in the Eurex process, required the study of amines and the determination of their degradation products. Gas-chromatographic analysis, potentiometric titration of free or acidified primary, secondary and tertiary amines, carboxylic acids valuations, and determination of free or bound nitric acid, are all employed. These methods, their results, and their application range are discussed. (auth)

25399 (SRARI-P-111) KINETICS OF THE EXTRACTION OF NITROSORUTHENIUM FROM NITRATE SOLUTIONS BY TRIBUTYL PHOSPHATE WHEN MIXING LIQUIDS IN THE CENTRIFUGAL FIELD. Pushlenkov, M. F.; Shchepetil'nikov, N. N.; Kuznetsov, G. I.; Kasimov, F. D.; Yasnovitskaya, A. L.; Yakovlev, G. N. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1971. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

Kinetics of extraction of nitrosoruthenium when mixing liquids in the centrifugal field was studied. It was shown that the evidence of some chemical forms of ruthenium in nitrate solutions causes the two-stage nature of the processes studied. The first diffusion stage is terminated in 0.6 second. The rate of the second chemical stage depends on the nitric acid concentration. The dependence of ruthenium distribution coefficient on the solution exposure time was established. (auth)

25400 SEPARATION OF TELLURIUM FROM SELENIUM AND OTHER FISSION PRODUCTS BY PRECIPITATION WITH 1,10-PHENANTHROLINE. Rickard, R. R.; Wyatt, E. I. (Oak Ridge National Lab., Tenn.). Anal. Chem.; 44: No. 4, 877-8(Apr 1972).

Bromide and fluoride do not interfere with the formation of chloro- or bromo-type tellurium-phenanthroline salts in nitrate-free solutions. Tellurium(VI) should be reduced to tellurium(IV) by digesting with hydrobromic acid. This should be followed with a metal reduction step with sulfur dioxide. Tellurium may be precipitated by this method directly from a solution of a reactor fuel specimen. (M.C.G.)

25401 METHOD FOR PURIFICATION OF DI-(2-ETHYLHEXYL) PHOSPHORIC ACID. Partridge, Jerry A.; Jensen, Reilly C. (to United States Atomic Energy Commission). U. S. Patent 3,641,226. 8 Feb 1972. Filed 24 Nov 1969.

Purification of di-(2-ethylhexyl)phosphoric acid (D2EHPA) in an organic solvent is accomplished by adding freshly precipitated copper hydroxide to the solution to form the copper salt of D2EHPA. The addition of acetone precipitates the copper salt which is separated from the solvent containing the impurities and washed. Treatment of the salt with a dilute mineral acid removes the metal ion, leaving the purified D2EHPA. (auth)

25402 PROCEEDINGS OF THE INTERNATIONAL SOLVENT EXTRACTION CONFERENCE. VOLUMES I AND II. Conference Held at The Hague, Netherlands, April 19-23, 1971. ISEC 71. London; Society of Chemical Industry (1971). 1614p. £25. (CONF-710417-(Vols. 1 and 2)).

One hundred and forty papers were presented under the following session titles: physical chemistry of extraction; drops and dispersions; nuclear applications and chemical process technology; chemistry of metals extraction; extraction equipment; applications to petroleum industry; coalescence; process development and metals extraction; nuclear applications and plant practice and technology; nuclear applications,-Np-Pu separation and transuranics; transport and interfacial phenomena; process development-extraction of non-metals; extraction of lanthanides; mathematical models and control; nuclear applications, Th, U, and amine systems; and case histories of industrial applications. Discussions are included in full. Abstracts for three papers appeared previously in NSA and separate abstracts were prepared for 46 additional papers. (UK)

For abstracts of individual papers see: 25213-25236, 25384-25386, 25403-25420, and 25975.

25403 REDUCTIVE EXTRACTION PROCESSING OF MOLTEN-SALT FUELS FOR BREEDER REACTORS. McNeese, L. E.; Watson, J. S.; Hannaford, B. A.; Kee, C. W.; Whatley, M. E. (Oak Ridge National Lab., Tenn.). pp 129-37 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From international solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

Reductive extraction affords a method of removing rare earth fission products and isolating ^{233}Pa from molten salt breeder reactor fuels. The chemistry of reductive extraction of lanthanides and actinides is reviewed. Chemical engineering experiments and development of countercurrent contactors for molten

salt and metal are discussed. Data are presented on flooding, hold-up, axial mixing, and mass transfer in packed columns. 6 references (auth)

25404 COMPUTER EVALUATION OF CHEMICAL FLOWSHEETS FOR PLUTONIUM PURIFICATION WITH TBP. Aochi, T.; Tsujino, T.; Kohsaka, A.; Hoshino, T. (Japan Atomic Energy Research Inst., Tokai). pp 138-46 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

In order to evaluate the plutonium purification process with tributyl phosphate (TBP), a calculation code for the system TBP–HNO_3–Pu was prepared on the basis of a batchwise countercurrent extraction cascade. By using this code, concentration profiles for transient or steady state conditions, and numbers of theoretical stages required, can be computed for a given process. The outline of the code is described and the calculated results are compared with those of experimental process studies. Results are also given for the application of this method to flowsheet calculations in connection with the JAERI Reprocessing Test Plant. 10 references (auth)

25405 USE OF SULPHATE IN SOLVENT EXTRACTION SEPARATION PROCESSES. Gourisse, D.; Bathellier, A.; Blanchard, J.-C. (CEN, Fontenay-aux-Roses, France). pp 147-54 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The complexing power of sulphate anions for tetravalent actinide elements is a very useful tool for improving solvent separation processes in a nitric acid medium and most interesting results were obtained in this connection. The stripping of tetravalent actinide elements from tertiary amine solutions is easily done with sulphuric–nitric acid solutions. Typical experiments with Pu(IV) and Np(IV) showed that stripping with a concentration factor >5 may be made with recovery ≥99.9%. Np–U and Pu–U separations by quantitative tributyl phosphate (TBP) extraction of uranium are greatly improved by introducing sulphuric acid in the aqueous nitric acid solution. Since sulphate complexes are stronger for tetravalent elements, the separation factor is greatly increased. In typical Pu–U separations uranium decontamination factors for plutonium $>10^7$ were obtained in 16-stage countercurrent extractions. 18 references (auth)

25406 INVESTIGATION ON THE NATURE OF DEGRADATION PRODUCTS IN THE SYSTEM 20 VOL.- PERCENT TRIBUTYL PHOSPHATE–DODECANE–NITRIC ACID. I. ENRICHMENT OF COMPLEXING PRODUCTS AND INFRA-RED STUDY. Stieglitz, L. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). pp 155-9 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The nature of the diluent degradation products responsible for the retention of zirconium in the Purex process is a matter of dispute. As hitherto described in the literature, zirconium retention is attributed either to nitroparaffins or to hydroxamic acids. The present work shows that the complexing agents are mostly formed on irradiation with low nitric acid concentrations, with a maximum yield at a nitric acid concentration of 0.4M in the organic phase. No relation was found between the amount of hafnium complexed in the solvent and the concentration of nitroparaffins. High-vacuum molecular distillation produced a concentrated residue with strong extracting power. From the appearance of absorptions at 1720, 1660, and 1615 cm^{-1}, it is concluded that the carbonyl fraction is most probably responsible for the complexing action of degraded solvents. 7 references (auth)

25407 FLOW-SHEET STUDIES ON REPROCESSING OF JAPAN EXPERIMENTAL FAST REACTOR FUEL IN A PUREX PLANT. Segawa, T.; Hoshino, T.; Kaya, A.; (and others) (Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan). pp 160-73 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The flowsheets proposed are characterized by a dilution system (about $1/_{15}$ dilution) except for the third Pu cycle; and use of 10% tributyl phosphate (TBP)/dodecane as a solvent. Detailed examination of these preliminary design flowsheets was started at the beginning of 1969. Measurements of the distribution ratio for uranium, plutonium, and ruthenium in 10% TBP/dodecane–HNO_3 systems were performed since these were necessary for flowsheet design. A computer code for calculating concentration profiles in a contactor bank was developed and used for flowsheet simulation. Proving tests of designed flowsheets were subsequently carried out using unirradiated uranium and plutonium in a glove box. The results of distribution ratio measurements, of the proving tests, and of the flowsheet simulation are described in detail. 9 references (auth)

25408 PROGRESS IN TRIBUTYL PHOSPHATE TECHNOLOGY AT THE SAVANNAH RIVER PLANT. Orth, D. A.; McKibben, J. M.; Scotten, W. C. (E. I. du Pont de Nemours and Co., Aiken, S. C.). pp 514-33 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

Advances have been made in several aspects of irradiated fuels processing at the Savannah River Plant. Correlation of laboratory and plant data shows that behaviour of fission-product zirconium in the solvent extraction system can be attributed to an equilibrium between two species of zirconium in the solvent phase. Residence times in the solvent extraction system determine the approach to equilibrium and affect the decontamination from zirconium. Short-residence centrifugal contactors have given good service as the first bank in the Purex system. Maintenance requirements have been small, decontamination performance is satisfactory, degradation of solvent by radiation is low, and high-feed activities are tolerated. Hydroxylamine nitrate reduces plutonium more rapidly and more completely than does hydroxylamine sulphate and has been substituted for the latter in the Purex second plutonium cycle and in recovery of ^{238}Pu. Loss of plutonium to various waste streams has decreased. Laboratory tests show that ferrous nitrate-hydroxylamine nitrate might be a suitable substitute for ferrous sulphamate in the partition of plutonium and uranium. Solvent containing 15% TBP was tested as a replacement for 30% TBP in a neptunium purification cycle. Decontamination from zirconium and thorium improved, while neptunium losses to the spent solvent decreased somewhat. Conditions for the test were derived from computerized flowsheet calculations. A graphical representation of the computer calculations was developed and has proved generally useful for flowsheet selection. 24 references (auth)

25409 IMPROVEMENT OF THE PROCEDURE USED TO TREAT HIGHLY IRRADIATED FUELS. (EXAMPLE OF THE UTILISATION OF COMPLEXING AND REDOX AGENTS IN A SOLVENT EXTRACTION PROCESS). Breschet, C.; Miquel, P. (CEN, Fontenay-aux-Roses, France). pp 565-76 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The procedure used at Marcoule for the treatment of irradiated uranium was modified to obtain better fission product decontamination and also to simplify the purification cycle for plutonium nitrate. During recent operations it has been shown that problems such as interphase precipitation and difficulties in obtaining the desired decontamination in mixer–settlers could be resolved by the addition of very small quantities of hydrofluoric acid to the aqueous feeds to the first co-decontamination cycle for uranium and plutonium. In the second cycle, plutonium is generally concentrated and purified in pulse columns using a recycle flowsheet, which uses extraction with tributyl phosphate followed by stripping in the presence of the reducing agent uranous nitrate stabilized with hydrazine. Flowsheet performance has shown that this cycle gives good decontamination (DF > 10^4) as well as concentrating the plutonium (CF > 100). 15 references (auth)

25410 CHEMICAL ASPECTS OF SOLVENT EXTRACTION ON PLANT SCALE AT EUROCHEMIEC. van Geel, J.; Joseph, C.; Detilleux, E.; (and others) (Eurochemic Co., Mol, Belgium). pp 577-92 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

Some chemical aspects are discussed of reprocessing nuclear fuel at Eurochemic by solvent extraction using 30% tributyl phosphate as an extractant for uranium and plutonium, including the following application of uranous nitrate as a reductant for plutonium in air-pulsed columns; solvent stability and process performance under different radiation exposures; and formation of heavy phases and deposits under certain process conditions. 22 references (auth)

25411 TECHNOLOGICAL EXPERIENCE WITH EXTRACTION EQUIPMENT AT EUROCHEMIC. Joseph, C. J.; van Geel, J.; Detilleux, E.; Centeno, J. (Eurochemic Co., Mol, Belgium). pp 593-600 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

In the reprocessing of irradiated nuclear fuel from power and materials testing reactors, the Eurochemic Company uses both air pulsed columns and geometrically safe mixer–settlers as solvent extraction equipment. A description of the process and equipment is given and the technological experience with the equipment, collected during the 4 years of operation, is described. The influence of different parameters on the extraction performance is discussed, such as the total throughput, heating, and the presence of crud and heavy phase. The experience with direct air purge bottom interface control is described, and the choice of pulsed columns for a new plutonium cycle is discussed. 11 references (auth)

25412 LABORATORY STUDIES OF NITROUS ACID AND NEPTUNIUM BEHAVIOUR IN TBP EXTRACTION PROCESSES. Gourisse, D. (CEN, Fontenay-aux-Roses, France). pp 781-91 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The behaviour of ^{237}Np in the Purex extraction processes depends on the oxidation of this element to the hexavalent state according to the reaction $NpO_2^+ + \frac{1}{2}NO_3^- + \frac{3}{2}H^+ \rightleftharpoons NpO_2^{2+} + \frac{1}{2}HNO_2 + \frac{1}{2}H_2O$ with nitrous acid acting as a catalyst. A systematic study of the influence of various parameters (nitric acid, uranium, nitrous acid concentrations, temperature) was made in order to determine whether it would be possible to predict and control neptunium behaviour in these extractions. Analysis, distribution coefficients of HNO_2 in the system 30% TBP–dodecane–$UO_2(NO_3)_2$–HNO_3–H_2O, decomposition and repartition of nitrous acid in counter-current extraction experiments with laboratory mixer-settlers show that it is possible to control HNO_2 concentration in the aqueous phase for every stage of the Purex counter-current extractions. 19 references (auth)

25413 USE OF TRILAURYLAMINE IN THE PROCESSING OF IRRADIATED ^{237}Np. Berger, R.; Koehly, G.; Espie, J.-Y. (CEN, Fontenay-aux-Roses, France). pp 792-800 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

A solvent-extraction scheme for the processing of irradiated ^{237}Np using trilaurylamine and nitrate systems was developed. The flowsheet included three extraction cycles for (i) Np(IV) and Pu(IV) separation from aluminium and fission products; (ii) Np(IV)/Pu(III) mutual separation by selective extraction of the former; and (iii) Pu(IV) final decontamination. Major improvements in the overall decontamination and mutual separation of neptunium and plutonium were obtained from the use of capric acid in the scrubbing steps, giving decontamination factors of the order of 10^6. Furthermore, capric acid allowed a decrease in the SO_4^{2-} concentration in the backextracting solution from 3 to 0.5N. Both advantages are due to a negative synergistic effect between trilaurylamine and capric acid, resulting in a decrease of the distribution coefficients of the tetravalent species and therefore, since the reductant is in the aqueous phase, a greater reduction rate of Pu(IV). (8 references) (auth)

25414 COLUMN DESIGN AND DYNAMICS EVALUATION FOR FRACTIONAL EXTRACTION OF METALS. Cheng, S.-I. (Cooper Union for the Advancement of Science and Art, New York). pp 1025-36 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

An algorithm using transient-state approach and its computer program were developed to handle complex situations in the stagewise separation of metals by solvent extraction. It not only has the ability to determine numbers of actual stages rather than equilibrium stages for both scrubbing and extracting sections but also possesses the capacity to exhibit the dynamic behavior of the system by the technique of computer simulation. An example of separation of zirconium nitrate from hafnium nitrate was taken for demonstration in the column design and in the evaluation of start-up behavior and responses to sinusoidal or step inputs. The advantages of the method over the conventional steady-state approach are discussed. (35 references) (auth)

25415 STUDIES OF TRILAURYLAMINE IN NUCLEAR FUEL PROCESSING. Germain, M.; Bathellier, A. (CEN, Fontenay-aux-Roses, France). pp 1161-73 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

It is stated that this long chain tertiary amine has for some years been used at the Eurochemic plant for the final purification cycle for Pu, and from the experience gained extension of its field of application to other fuel reprocessing problems is under consideration. An important feature of these amines is their ability to extract tetravalent metals, such as Np and Pu, in the first fuel processing cycle. This is possible because of the high distribution coefficients of tetravalent elements from nitric acid solutions into the amines, whilst extraction of U and the main fission products remains relatively low. A thorough knowledge, is, however, required of damage to the solvent caused by chemical agents and ionizing radiation of the feed solution. With regard to the radiolytic stability of long chain amines very little change in their extractive properties and ease of phase separation appears to occur after prolonged irradiation. In the case of TLA, however, difficulties have been experienced in measuring the extent of degradation to secondary amine. The studies described are centered on this point, since secondary amine formation seems to be the factor most likely to interfere with process efficiency. The chemical stability appears satisfactory. It was concluded that the stability of TLA, protected from the action of nitrous acid by an antinitrite compound, is such that its use in the first cycle of a natural U fuel processing plant can be contemplated, and under these conditions the recovery and purification of Pu and Np should be possible in two extraction cycles. (20 references) (UK)

25416 INFLUENCE OF SOME COMPLEXING AGENTS ON THE EXTRACTION RATE OF PLUTONIUM FROM ORGANIC TO AQUEOUS PHASE. Barocas, A.; Baroncelli, F.; Dworschak, H (CSN, Rome). pp 1174-9 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The rate of extraction of plutonium from organic solutions of tertiary alkylammonium nitrate salts to aqueous nitrate solutions can be influenced by the presence of suitable complexing agents in the aqueous electrolyte phase. Increasing this rate is of importance in the reprocessing of irradiated nuclear fuel by amines. Therefore, the influence of eleven complexing agents on the rate of extraction of plutonium from organic to aqueous phases was studied. The implications of the presence of these complexing agents on the distribution of uranium was also evaluated. (13 references) (auth)

25417 DEVELOPMENT OF AN AMINE-EXTRACTION FLOWSHEET FOR THE RECOVERY OF URANIUM FROM SPENT HTR-U-Th FUEL ELEMENTS AFTER A HEAD-END CHLORINATION (CHLORINEX PROCESS). Thomas, R. (Kernforschungsanlage, Juelich, Ger.). pp 1188-95 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The flowsheet developed has a total of 14 theoretical stages, including 2 extraction- and 5 scrub-stages in the uranium-extraction battery, and 3 strip- and 4 scrub-stages in the uranium-strip battery. (8 references) (auth)

25418 EXPERIENCE WITH CENTRIFUGAL EXTRACTORS: COMPARISON WITH OTHER TYPES OF EXTRACTORS. Bernard, C.; Michel, P.; Tarnero, M. (CEN, Fontenay-aux-Roses, France). pp 1282-1301 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

Technical and economic aspects are compared for the three extractor types generally considered in the nuclear field, viz., mixer-settlers, pulse columns, and centrifugal contactors. (5 references) (auth)

25419 SOME EXPERIENCES IN THE DEVELOPMENT, DESIGN, AND SCALE-UP OF SOLVENT EXTRACTION PROCESSES FOR THE RECOVERY OF IRRADIATED NUCLEAR FUELS. Naylor, A.; Larkin, M. J. (British Nuclear Fuels Ltd., Sellafield, Eng.). pp 1356-72 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The data required for the design of a solvent extraction system are considered, and it is shown that where the chemistry of the extraction process is simple and well understood only small-scale experiments are necessary to obtain all the data necessary for design of a full-scale mixer-settler plant. The design requirements of a more complex system are then considered, as exemplified by the solvent extraction of uranium and plutonium from irradiated nuclear fuel, and the place of the pilot plant in the development of such a process is considered. The experience of scale-up gained in the development and early operation of the Windscale separation process is described. (38 references) (auth)

25420 PLENARY PAPER. I. Spence, R. (Univ. of Kent, Canterbury, Eng.). pp 1450-4 of Proceedings of the International Solvent Extraction Conference. Vol. I and II. London; Society of Chemical Industry (1971).

From International solvent extraction conference; The Hague, Netherlands (19 Apr 1971). See CONF-710417-(Vol.1 and 2).

The application of solvent extraction techniques to the nuclear energy industry is discussed and an historical account of the techniques from their early nuclear applications to the present day is given. (UK)

25421 PATH TO THE DOMESTIC PRODUCTION OF PLUTONIUM. VIII. LOG OF REPROCESSING DEVELOPMENT EXPERIMENTS. Aochi, Tetsuo. Genshiryoku Kogyo; 16: No. 7, 59-64(Jul 1970). (In Japanese).

The third hot run, carried out during August 1968 to March 1969, was used to reexamine problem areas identified in the previous tests, studying specifically the release of radioactive iodine at various stages of the process, burnup rate measurements, improvements in the decontamination factor, and the Pu recovery rate. Fuel rods of 600 MWd/t, cooled 400 and 85 days, were used in the tests. It was found that iodine is released throughout the dissolution process, being increased sharply when the dissolver solution was dissolved. Material balance studies indicated that the $[HNO_3]/[U]$ ratio for the dissolution reaction was below 3; this is attributed to the recycling of HNO_3 formed by the oxidation of NO. The previously described modifications of the process were reexamined; TBP extraction and ion exchange purification were again employed. The procedures used for control analysis were also examined. (TTT)

25422 PATH TO THE DOMESTIC PRODUCTION OF PLUTONIUM. VII. LOG OF REPROCESSING DEVELOPMENT EXPERIMENTS. Aochi, Tetsuo. Genshiryoku Kogyo; 16: No. 6, 58-62(Jun 1970). (In Japanese).

In the second hot run, carried out during June to August 1968, fuel rods of more than 500 MWd/t were used after cooling for more than 200 and 125 days. The rods of the second group were classed in 3 sections, representing burnups of 290, 580, and 870 MWd/t. The effect of the cooling time on the rate of the ^{131}I release was followed. There was a loss about 0.15% of U and Pu in the Al decladding bath but the burnup had only a slight effect on the dissolution rate of the rods. The greatest ^{131}I (amounting to about 0.5 mCi, or about 1 to 3% of the total present in the system) losses were observed when the solution was diluted under stirring to prevent crystallization. Study of the effect of various extraction and separation processes indicated that operating conditions in one of the towers affected greatly the Pu recovery rate. TBP extraction and ion-exchange purification techniques were used in the process. The decontamination factors prevailing in the various processes were determined. (TTT)

25423 PROCESS FOR PROCESSING CANNED IRRADIATED CERAMIC FUEL ELEMETS. Manevy, Georges; Matcheret, Georges U. S. Patent 3,644,104. 22 Feb 1972. Filed 23 Oct 1968.

The decanning step in the reprocessing of ceramic nuclear fuel elements is carried out by cutting the fuel elements in short-length fragments and then crumbling the fuel into a powder, which leaves the can fragments by processing the fuel fragments in a ball mill. Prefluoration of the fuel into UF_4 and PuF_4 may take place in the ball mill. (Official Gazette)

ENGINEERING

Energy Conversion

Refer also to abstracts 25957 and 26128.

25424 (AGC-1349) ANALYSIS AND PRELIMINARY DESIGN STUDY OF NUCLEAR ROCKET TURBOPUMP SYSTEMS. Final Summary Report. Smith, J. R.; Carter, T. A.; Vanica, D. F.; Mondok, F. (California Univ., Livermore. Lawrence Radiation Lab. Aerojet-General Corp., Azusa, Calif.). 18 Oct 1957. 82p. Dep. NTIS.

Declassified 27 Oct 1971.

An evaluation of nuclear rocket propulsion system turbopump designs is presented. It was concluded that a lightweight turbine for such applications can be built. Information is included on cycle analysis, preliminary design, weight studies, radiation heating, controls, and basic equation development. (J.R.D.)

25425 (AGN-8182-1(Rev.)) LARGE MILLIWATT RADIOISOTOPE THERMOELECTRIC GENERATOR PROGRAM. PARAMETRIC STUDY DATA. VOLUME I. GENERAL CHARACTERISTICS OF AN ADVANCED, LARGE MILLIWATT RTG. Carney, Carl; Lamb, Ivan; Rockwell, Don; Ruehle, William; Toomb, Donald; Whittum, Hal (Aerojet-General Nucleonics, San Ramon, Calif.); Sonnenschein, George; Strop, Hans R.; Zanders, Donald L. (Monsanto Research Corp., Dayton, Ohio). Apr 1966. Contract AT(30-1)-3628. 219p. Dep. NTIS.

Declassified 2 Nov 1971.

A parametric study was performed to investigate the general characteristics of advanced, large milliwatt, radioisotope thermoelectric generator systems that could be constructed from materials available today. The power level specified was the range from 150 to 1000 mw; three fuel forms were specified; and the operating ambient temperature range was from 28 to 90°F. It was concluded that such systems could be designed and fabricated with only modest extensions of state-of-the-art materials and fabrication technology. The several computer programs used in this study, their application to the problems posed, and the results are reported in this volume. (auth)

25426 (AGN-8182-2(Rev.)) LARGE MILLIWATT RADIOISOTOPE THERMOELECTRIC GENERATOR PROGRAM. PARAMETRIC STUDY DATA. VOLUME II. APPENDIXES. Carney, Carl; Lamb, Ivan; Rockwell, Don.; Ruehle, William; Toomb, Donald; Whittum, Hal (Aerojet-General Nucleonics, San Ramon, Calif.); Sonnenschein, George; Strop, Hans R.; Zanders, Donald L. (Monsanto Research Corp., Dayton, Ohio). Apr 1966. Contract AT(30-1)-3628. 309p. Dep. NTIS.

Declassified 2 Nov 1971.

Appendixes are included on the TEHE program for thermoelectric heater evaluation, optimum fuel capsule dimensions, cold junction temperatures, parametric study results, fuel costs, computer codes for thermoelectric generators, thermocouple reliability, materials data, strontium-90 fuel forms, plutonium-238 fuel forms, promethium-147 fuel forms, and thermal insulation. (J.R.D.)

25427 (AGN-8186) LARGE MILLIWATT, RADIOISOTOPE THERMOELECTRIC GENERATOR PROGRAM. Final Technical Report. Carney, Carl; Lamb, Ivan; Rockwell, Don; Ruehle, William; Toomb, Donald; Whittum, Harold (Aerojet-General Nucleonics, San Ramon, Calif.); Sonnenschein, George; Strop, Hans R.; Zanders, Donald L. (Monsanto Research Corp., Dayton, Ohio). May 1966. Contract AT(30-1)-3628. 164p. Dep. NTIS.

Declassified 2 Nov 1971.

The general characteristics of advanced, large milliwatt, radioisotope thermoelectric generator systems were investigated to determine if such could be constructed from materials available today and in the near future. The power level specified was the range from 150 to 1000 mW(e); three fuel forms were specified; the operating temperature range (ambient) specified was from 28 to 90°F. The study was performed in three phases: liaison, an investigation into the potential applications of such systems; parametric study, a determination of the interplay of parameters on the design of such systems; and the conceptual design of four systems selected by the AEC. The liaison and parametric study phases are described along with the conceptual designs. (auth)

25428 (N-71-35230) PERFORMANCE EVALUATIONS OF A NONFUELED AND A UO_2-FUELED CYLINDRICAL THERMIONIC CONVERTER. Shimada, K. (Jet Propulsion Lab., Pasadena, Calif.). 1 Aug 1971. Contract NAS7-100. 14p. (NASA-CR-121897; JPL-TR-32-1539). NTIS.

Two cylindrical thermionic energy converters similar to those in a flashlight type thermionic fuel element were tested electrically. One converter was not fueled, but the other was fueled with UO_2 imbedded in six pencil-lead-size holes in the emitter, which was made of rhenium. The nonfueled converter was tested primarily for endurance under open-circuit conditions that might occur as a result of a loss of cesium or a broken power lead. The UO_2-fueled converter was tested for fuel-converter compatibility under normal operating conditions with an electric load. The nonfueled converter showed no change in its performance during 4000 h of testing, whereas the output current of the UO_2-fueled converter degraded 15% during 2400 h bf testing at 2000°K. Measurements on the UO_2-fueled converter showed an increase in the collector work function and an increase in the bare emitter work function, which indicate that the degradation was caused primarily by foreign deposits on the collector, probably uranium that effused from the UO_2-fuel through the emitter. (auth) (STAR)

25429 IMPEDANCE CHARACTERISTICS OF THE FINITE-LENGTH ANNULAR INDUCTION MHD GENERATOR. McCutcheon, Martin J.; Russo, Andrew W. (Univ. of Alabama, Birmingham). J. Appl. Phys.; 43: No. 4, 1542-6(Apr 1972).

An analysis of the annular-induction MHD (magnetohydrodynamic) generator is carried out for a model employing a finite-length winding and a constant-velocity fluid flowing in the annulus. An expression for the phase impedance is derived which accounts for entrance and exit of the fluid into the winding region. Impedance characteristics are presented which allow comparison with the infinite-length case in terms of dimensionless parameters. (auth)

25430 HEAT ENGINES. (to Atomic Energy of Canada Ltd.). British Patent 1,259,653. 12 Jan 1972. Priority date 14 Feb 1969, Canada.

A small heat engine is described that converts thermal energy derived from the decay of a radioisotope source into mechanical and electrical energy. The engine works on a closed cycle utilizing a working medium that is gaseous at all times. (B.L.M.)

25431 AXIAL CURRENT LEAKAGE IN SEGMENTED MHD GENERATORS. Cutting, John Carl. Stanford, Calif.; Stanford Univ. (1971). 105p. University Microfilms Order No. 72-5904.

Thesis.

Experiments were performed in a segmented MHD generator with an argon-nitrogen-NaK plasma to investigate the phenomena of axial current leakage between adjacent electrodes. Nonequilibrium phenomena were diminished by the addition of nitrogen which comprised up to 20% of the total flow. Electric and magnetic fields were applied with maximum transverse current density of 2 amperes/cm^2 and maximum Hall parameter of 6. The generator was composed of six tungsten electrode pairs inserted into a rectangular quartz channel. The measuring or "test" electrode was electrically guarded and relaxation effects minimized by three upstream electrode pairs and two pairs downstream. The anode and cathode of this "test" electrode were divided into three segments each and the current direction and magnitude measured at each segment. Axial current leakage was indicated by reversal of current direction in one or more of the segments. Simultaneous measurements of Hall voltage between adjacent electrode pairs were obtained and voltage probes were installed in the quartz side wall between the "test" electrode and the pair immediately upstream to measure voltage profiles in the plasma. Axial current leakage between adjacent electrodes was measured and found to be a function of increasing transverse current density. The "critical" transverse current density necessary to cause leakage decreased with increased Hall parameter, decreased plasma temperature and decreased percentage of nitrogen additive. In all experiments current leakage between adjacent cathodes was significantly greater than between adjacent anodes. Cathode leakage currents in excess of 50% of the transverse current were measured with no indication of breakdown or arcing between adjacent electrodes. Hall voltages were observed to have an asymptotic limit with increasing transverse current density. The value of this limit was a function of nitrogen percentage and Hall parameter. Maximum measured Hall field across a single insulator gap was approximately 9 kV/meter. Measurements of current direction in the channel indicated that the current tended to flow more downstream, limited by the Hall angle, with increasing transverse current density. A computer model for calculation of electrical current distributions in a segmented MHD device was written to interpret and predict the experimental data. The program consisted of a coupled solution of the current stream function equation and the electron

energy and continuity equations. Results of comparison of the theoretical results with the experimental data indicated that the leakage phenomena at the cathode was modeled relatively well while the anode results were less accurately predicted. Computed Hall voltage response was in excellent agreement with the measured data. The calculation results indicated that the increase in electrical conductivity in the plasma along the electrode walls was responsible for leakage. (Diss. Abstr. Int., B)

25432 MAGNETOHYDRODYNAMIC PULSE GENERATOR. Pozwolski, E. Compt. Rend., Ser. A; 274: No. 1, 123-5(3 Jan 1972). (In French).

A MHD pulse generator using supercritical water vapor, made conducting by the addition of salt, is described. The ionization of the salt is linked with the high dielectric constant of the vapor and increases with decreasing temperature according to the Kirkwood formula. (France)

25433 THERMODYNAMIC PECULIARITIES AND POWER EFFICIENCY OF USING OXYGEN-ENRICHED AIR IN INSTALLATIONS WITH MHD GENERATORS. Koryagina, G. M. (Moscow Engineering Economics Inst.). Izv. Vyssh. Ucheb. Zaved., Energ.; No. 10, 77-82(Oct 1971). (In Russian).

An analysis is made of the individual components of the formula for the efficiency of an electric power plant with MHD generator using oxygen. Consideration is given to four versions of initial conditions of comparison of the ideal cycles with MHD generators utilizing the products of combustion of natural gas with an oxidizer with various concentrations of oxygen. Comparative analysis shows the inefficiency of oxygen enrichment in the case of identical pressure and in the case of identical temperature preceding the MHD generator. Oxygen enrichment of air imparts an energetic effect in the case of constant temperature or electrical conductivity behind the channel of the MHD generator, which confirms detailed calculations of the thermal systems and of the MHD generators themselves. (JPRS)

25434 THEORETICAL AND EXPERIMENTAL ASPECTS OF THE MAGNETOHYDRODYNAMIC AND NON-MHD RAYLEIGH–TAYLOR INSTABILITY. Cole, Roger Lynn. Evanston, Ill.; Northwestern Univ. (1971). 170p. University Microfilms Order No. 72-7765.

Thesis.

The linearized small perturbation theory for the magnetohydrodynamic Rayleigh–Taylor instability with the magnetic field parallel to the acceleration developed by D. J. BenDaniel and H. Hurwitz, Jr. was extended to include the effect of surface tension. The solution relating the growth rate of the instability to the wave number of the perturbation was shown to be the same as the non-magnetohydrodynamic solution multiplied by an attenuation factor. The attenuation factor is a function of two parameters relating to the electrical and magnetic properties of the fluid. Approximate solutions are presented for infinite electrical conductivity and for low to medium conductivity with a strong magnetic field. The non-linear, non-magnetohydrodynamic rectangular wave theory developed by Enrico Fermi was also extended to include surface tension. For wave numbers approaching zero (infinitely long waves) the growth function is a hyperbolic cosine for the condition of zero initial velocity. Such a growth function was also predicted by small perturbation theories and by Fermi's non-surface tension theory (with initial conditions modified for zero initial velocity). For shorter wave lengths the surface tension terms give rise to oscillating growth. The oscillation was not observed experimentally, however. The experiment consisted of two parts using different fluids. The first part used water as the working fluid. The method of data analysis consisted of fitting sine waves to photographic images of the growing wave. The technique also eliminated the need to measure the initial amplitude of the wave. The results of this part of the experiment gave close agreement with the linear, non-MHD small perturbation theory for nondimensional wave numbers less than one. The technique of fitting a sine wave to the photographic images was extended to the second order wave (having twice the wave number of the first order wave) for one of the experimental runs. Qualitative agreement with the second order of C. T. Chang's nonlinear theory was obtained. The second part of experiment used mercury as the working fluid. The meniscus of the mercury in the test chamber was used as the initial perturbation. This method of obtaining the initial perturbation has not been previously reported. An attempt to measure the effect of a magnetic field parallel to the acceleration was made but the results were inconclusive. The wave form of the growing mercury wave was shown to approximate a rectangular wave. Qualitative agreement with Fermi's rectangular wave theory (with zero initial velocity) was obtained. (Diss. Abstr. Int., B)

25435 THERMIONIC CONVERSION ATOMIC DIODE BATTERY. (to McDonnell Douglas Corp.). British Patent 1,268,472. 29 Mar 1972. Priority date 29 Jan 1969, United States.

A radioisotopic diode battery is described comprising an emitter capsule including a radioisotope fuel pellet as a source of power, a layer of shielding and encapsulation for the fuel pellet, and an outer housing. The housing hermetically encloses the emitter capsule and provides additional shielding for the fuel pellet. Provisions are made for maintaining a low pressure space between the emitter and collector. Provisions are also made for electric output transfer to its work location. (J.R.D.)

Facilities and Equipment

Refer also to abstracts 25987 and 27165.

25436 (AECL–4076) ROTOR: A CDC 6600 COMPUTER CODE FOR THE ANALYSIS OF PUMP PERFORMANCE. Wong, P. Y. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Jan 1972. 62p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

The ROTOR code is a part of a package of computer programs designed to provide performance characteristics of a pump. ROTOR covers the part on rotor dynamics, including static and dynamic behavior of the rotor system. A typical pump for coolant circulation in a nuclear power reactor is presented as an application. (auth)

25437 (ANL–7896) HIGH-TEMPERATURE CALORIMETER SYSTEM FOR USE WITH MATERIALS CONTAINING PLUTONIUM. Fischer, D. F.; Leibowitz, L.; Chasanov, M. G. (Argonne National Lab., Ill.). Dec 1971. Contract W-31-109-eng-38. 23p. Dep. NTIS.

A high-temperature calorimeter system has been constructed to conduct enthalpy increment studies on radioactive materials at temperatures to 3600°K. Samples are heated by induction and dropped by a condenser-discharge technique into a modified commercial adiabatic calorimeter. Sample temperatures are measured by an automatic optical pyrometer, and calorimeter temperatures are obtained by quartz thermometry. Other features of the system and its overall operation are discussed. Performance and capabilities of the system were demonstrated by measurements of the enthalpy of solid tungsten, solid and liquid uranium dioxide, and solid and liquid uranium–plutonium dioxide. (auth)

25438 (CNLM–3294) POSSIBLE USES OF SEGMENTED HEAT EXCHANGERS. Rencenberger, R. W. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 10 Jan 1961. Contract [AT(30-1)-2789]. 4p. Dep. NTIS.

Declassified 3 Nov 1971.

Two new liquid metal schematics based on segmented heat exchangers were devised. The basic feature of the segmented heat exchanger, as applied here, is the existence of three distinct, separate flow paths. Systems based on these schematics will operate in a continually crossed over manner and accommodate failures by isolating the afflicted member. The major benefit of these arrangements is the elimination of the secondary pump matching requirement. Pump matching is now required only in the primary circuits. The first schematic shown offers a second advantage by requiring 8 less valves than the presently proposed liquid metal system. The second schematic shown requires 4 more valves than the present liquid metal system. (auth)

25439 (GAT-E–157) RELIABILITY STUDY OF THE OXIDE CONVERSION FACILITY. Wilcoxon, Ralph E. (Goodyear Atomic Corp., Piketon, Ohio). Aug 1971. Contract AT(33-2)-1. 65p. Dep. NTIS.

Thesis. Submitted to Ohio Univ., Athens.

From a study of historical data, a definable interdependency is shown to exist between the system over-all reliability and subsystem-component particular reliabilities in a tandem sense. A simplified mathematical model is used to show the nature of these interdependencies under exact operational and environmental conditions. This model is shown to be valid even under frequent repair, preventive maintenance, and random downtime policies. By comparison of the system over-all reliability on a theoretical and empirical basis, a prediction model is developed for determining the frequency of multiple failures per shutdown. The performance of the individual subsystems after design changes can be predicted. This prediction is based on the evaluation of these performances, additional design modifications, and changes in maintenance policies. These changes are recommended where needed. (auth)

25440 (NVO-38-29) VERTICAL HOLE DEVELOPMENT STUDY. Ash, James L.; Gatliff, Robert L.; Grovenburg, William W.; Mathis, Gerald C.; Walker, Joe A. (Fenix and Scisson, Inc., Las Vegas, Nev.). Oct 1971. Contract AT(26-1)-38. 303p. Dep. NTIS.

In the past, the degree of urgency attached to the construction of vertical large-diameter holes necessary for testing nuclear devices has precluded systematic investigation to determine the best method for constructing the holes. The hole development has been accomplished at great cost by increasing the capacity of conventional oil-well-drilling rigs and by modifying drilling practices. A study was undertaken to make a systematic analysis which could lead to new or improved system concepts resulting in faster and less expensive methods of vertical large hole development. It was concluded that the present rotary drilling system with improvements is the best concept available within the time constraint of five years. Significant improvements in the present rotary drilling system may be immediately achieved by better utilizing the energy sources inherent to the system. This can be accomplished by redesigning the presently used bits in order to both crush the rock into larger fragments and to utilize the pumping action of the individual cutters for better cleaning of the hole bottom. Additional time and cost savings may be realized by enlarging the present rotary tables to provide more energy to the drill bit. The principal recommendations are to redesign all of the bits used for drilling holes larger than 72-in. dia and consider using a larger rotary table. (auth)

25441 (SZS-16/71) DIMENSIONING AND TESTING OF INHALATION DEVICES FOR ANIMAL EXPERIMENTS WITH RADIOACTIVE SOLID PARTICLE AEROSOLS. Ullmann, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Aug 1971. 61p. (In German). Dep. NTIS (U. S. Sales Only).

The essential physical and technical fundamentals for dimensioning of devices for production, measurement, and application of radioactive aerosols with particle sizes from about 0.05 to 0.5 μm are described with special regard to aerosol production. Methods for testing these devices were also developed. The solid aerosol particles are produced by atomization of solutions or suspensions with a two-component jet and subsequent volatilization of the solvent or liquid component. The results are applied to the construction and testing of three inhalation devices designed for a maximum exposure time of 60 min. Inhalation device No. 1 serves for application of β-active solid particle aerosols to 96 mice. Inhalation devices No. 2 and 3 are suitable for application of α- and γ-active solid particle aerosols to 20 rats each. Device No. 3 is provided for inhalation studies with radon and its short-lived daughter products at different concentrations of solid particle aerosols. A subsequent reconstruction of devices No. 2 and 3 for experiments with about 100 animals is possible. (auth)

25442 DETECTING ONSET OF BOILING IN A LIQUID. (to Siemens Aktiengesellschaft). British Patent 1,260,792. 19 Jan 1972. Priority date 1 Mar 1969, Germany.

An apparatus for detecting the onset of boiling of liquids, such as liquid-metal coolants for a nuclear reactor, is described. The apparatus includes a funnel-shaped tube arranged with its wide end immersed in the liquid and its narrow end projecting upwardly from the liquid so that the onset of boiling in the liquid will cause a rise of liquid within the tube to a height above the level of the liquid outside the tube and detection means extending in the vicinity of the narrow end and operative in dependence with a rise in the liquid to produce a response indicative of the onset of the rise. (B.L.M.)

25443 HEAT EXCHANGER FOR PRODUCTION OF STEAM. Lievense, Kornelis (to Nederlandse Organisatie Voor Toegepast - Natuurwetenschappelijk Onderzoek Ten Behoeve Van Nijverheid, Handel En Verkeer). British Patent 1,262,377. 2 Feb 1972. Priority date 30 May 1968, Netherlands.

A heat exchanger in which steam is produced and which operates with liquid metal as a heat transferring medium employs pockets of metal remaining relatively stagnant to provide a thermal barrier in the transition area from tube to tube plate. Steam tubes attached to a tube plate circulate the heat transferring medium, and a portion of the tube lengths are enclosed in pockets each open at one end to the interior of the casing to permit entry of the heat transfer medium circulating in the casing. The other end of the pockets is closed by the tube plate to provide relatively stable pockets for the thermal barrier. (B.L.M.)

25444 SODIUM VAPOR TRAP. (to Borg-Warner Corp.). British Patent 1,259,935. 12 Jan 1972. Priority date 5 May 1969, United States.

A sodium vapor trap for sealing a rotary shaft to a housing through which the shaft extends is made up of two parts, a rotary member carried by and sealed to the shaft and a stationary member carried by and sealed to the housing. The rotary member has axially spaced, first transverse baffles projecting away from the axis, and the stationary member has axially spaced, second transverse baffles projecting towards its axis and cooperating with the first baffles to form a tortuous passageway adapted to communicate the space within the housing with the space outside the housing. The members constitute means for maintaining the trap at a temperature above the melting point of the sodium such that vapors between the members is condensed to the liquid state. The first and second baffles are adapted to slope downwardly toward the interior of the housing so that the liquid sodium flows freely into the space within the housing. (B.L.M.)

25445 PIPE PLUG. Amesz, Jan; Farfaletti-Casali, Flaviano; Munsch, Fernand; Morini, Romano; Croue, Christian (to EURATOM). British Patent 1,261,010. 19 Jan 1972. Priority date 28 Apr 1969, Luxembourg.

A pipe plug suitable for closure of pressure pipes in nuclear reactors is described. In the plug, thrust is applied to a sealing member by a spring with pressure adjustable by means of a central adjusting screw adapted to rotate in a screw-threaded nut that locks in the pipe via locking pawls pivoted to the nut, which is secured against rotation. (B.L.M.)

25446 GAS-LIQUID SEPARATOR. Robbins, Charles Hartman; Fitzsimmons, George William; Hughes, Robert Leo; Moen, Robert Henry (to General Electric Co.). British Patent 1,259,711. 12 Jan 1972. Priority date 21 Nov 1968, United States.

A gas-liquid separator includes an elongated vortex tube having a gas-liquid mixture inlet at one end and an outlet at the other end; means adjacent to the inlet for receiving a gas-liquid mixture and for establishing in the vortex tube a gas vortex surrounded by a liquid vortex. A liquid discharge channel surrounds the vortex tube and means are provided adjacent to the outlet of the vortex tube for directing the liquid vortex into the liquid discharge channel. A number of longitudinal vanes positioned in the liquid discharge channel have axially directed leading ends for intersecting the liquid flow and arresting the vortex flow of the liquid. The separator is suitable for use in a pressure vessel of a nuclear reactor steam generator. (B.L.M.)

25447 ADVANCES IN MEDICAL PHYSICS. Symposium Papers of the Second International Conference on Medical Physics, Boston, Massachusetts, August 11-15, 1969. Laughlin, John S. (ed.). Boston; Second International Conference on Medical Physics, Inc. (1971). 370p. (CONF-690844).

Separate abstracts were prepared on three papers. Other papers discuss methods for measurement of human physiological responses, the physical aspects of nuclear medicine, applications of ultrasound in medicine, and information processing. (C.H.)

For abstracts of individual papers see: 25750, 25751, and 25838.

25448 NOTES ON COMPRESSIBLE GASKET AND BRIDGMAN-ANVIL TYPE HIGH PRESSURE APPARATUS. Wakatsuki, Masao; Ichinose, Kazuaki; Aoki, Toshio (Tokyo Shibaura Electric Co., Ltd.). Jap. J. Appl. Phys.; 11: No. 4, 578-90(Apr 1972).

The squeezing process of a disc-shaped gasket, which is compressed between Bridgman anvils, is analyzed by a simple model. It is made clear that plastic flow and pressure distribution in the disc is governed by its thickness. A normalized characteristic thickness, which can be determined for each disc material by thickness measurement on squeezed discs, is defined and correlated experimentally with shear strength of the material under pressure. According to the correlation, a simple method is developed to evaluate substances for solid pressure materials. A Bridgman anvil apparatus and sample assemblies for it were so designed as to provide the best performance in a range of from 100 kbar to 200 kbar. Noncatalytic syntheses of diamond, stishovite, and cubic boron nitride are described as examples of utilizing the apparatus. Some features of anvil fracture are also described. (auth)

25449 POWER OPTIMIZATION FOR PRESCRIBED THERMAL POLLUTION. Nahavandi, Amir N.; Pappas, Michael. J. Power Div., Amer. Soc. Civil Eng.; 97: No. PO-3, 631-47 (Jul 1971).

The optimum design of condenser cooling system for steam power plants requires the maximization of plant power subject to a prescribed temperature rise at the immediate point of effluent discharge into the main water source. To achieve this objective with a relatively small condenser pumping capacity, a portion of the total flow is first passed through the condenser and then mixed with the unheated water before final discharge into the water source. A portion of the condenser discharge generally recirculates upstream, mixes with a portion of the

incoming flow, and eventually enters the condenser intake manifold after having heat transfer with the atmosphere. It is shown that this general procedure does not provide the maximum power and is accompanied with a loss of plant power. To increase the plant power capability, it is necessary to prevent the mixing of the recirculation and the incoming flows and also to establish a relationship between the recirculation and the condenser flows as specified. (auth)

25450 SIZE SELECTIVE DUST SAMPLER WHICH CONFORMS TO THE LUNG MODEL PROPOSED BY THE I.C.R.P. TASK GROUP ON LUNG DYNAMICS. Stevens, D. C.; Stephenson, J. (Atomic Energy Research Establishment, Harwell, Eng.). J. Aerosol Sci.: 3: No. 1, 15-23(Feb 1972).

A single stage size selective dust sampler is described which has a particle size-deposition curve nearly identical to that of the pulmonary compartment of the lung proposed by the ICRP Task Group on Lung Dynamics (1966). Monodisperse polystyrene, thoria and uranyl acetate particles were used to obtain size-deposition curves for production models of a 2 l/min^{-1} sampler for use as a personal air sampler, and a prototype 30 l/min sampler. The design of the sampler allows a considerable amount of flexibility in the choice of separation characteristics and it is believed that the sampler could be modified to conform to any future changes in the lung model deposition curves. (auth)

25451 DEVELOPMENT OF MECHANICAL PUMPS FOR SODIUM. Taka, Shusei (Ebara Mfg. Co. Ltd., Tokyo). FAPIG (Tokyo); No. 62, 95-9(Aug 1971). (In Japanese).

A small sodium pump was made and tested using sodium heated to 550°C in a test loop. Test items were performance, temperature distribution at various parts, vibration, and transition characteristics during sudden stop. The pump was disassembled after the test for close examination. Very little wear of friction parts was noted and no anomaly was found in sealing parts and a driving shaft. The pump is a centrifugal type with free liquid surface. Aperture diameter is 80 mm, and rate of discharge is 1 m^3 min at 2,400 rpm. Main construction material is SUS 32. The pump was driven by variable speed induction motor controlled by a thyristor. Sealing of the shaft is accomplished with 2 mechanical face seals lubricated by No. 90 turbine oil. The oil pressure was kept 1 kg/cm^2 higher than that of cover gas to prevent leakage of the gas. The friction parts were made of hard alloys. Thermal insulation was satisfactory and the oil temperature at the sealing parts of the shaft did not exceed 40°C. Thermal shock tests were not made. (Japan)

25452 EVALUATING THE OUTPUT OF X-RAY TUBES. Trew, D. J. (McMaster Univ., Hamilton, Ont.). Radiography; 38: No. 446, 26-35(Feb 1972).

Factors in the output of the x-ray tube that affects the formation of the radiologic image are; distribution in time of tube output, maximum energy of the primary beam, the apparent geometry and distribution of energy at the radiation source, and the intensity of the output in terms of roentgen value. The methods of measurements of these parameters were reviewed and a series of procedures, that would provide a convenient method of periodic evaluation, selected. (UK)

Heat Transfer and Fluid Flow

Refer also to abstracts 25438, 25443, 25449, 25530, 25706, 25708, and 27380.

25453 (AERE-R-6661) CHUGGING FLOW. Hawtin, P. (Atomic Energy Research Establishment, Harwell (England)). Dec 1970. 22p. Dep. NTIS (U. S. Sales Only).

Two-phase systems are prone to a number of types of instability. One of these is chugging flow. This form of gross instability has been little studied despite its potentially damaging nature. The nature of and the physical conditions leading to chugging flow are reviewed. Particular attention is paid to three stages of the "chugging cycle", which are: nucleation of the vapor cavity; growth of the vapor cavity; and collapse of the vapor cavity. (auth)

25454 (CONF-720307-1) PROSPECTS FOR FURTHER IMPROVEMENT IN ENHANCED HEAT TRANSFER SURFACES. Thomas, David G. (Oak Ridge National Lab., Tenn.). [1971]. 34p. Dep. NTIS.

From second conference on water desalination; Bhavnagar, India (1 Mar 1972).

The prospects are examined for further improvement in enhanced heat transfer surfaces, specifically surfaces on vertical tubes used for the evaporation and condensation at atmospheric pressure of downward flowing thin films of water. Such heat transfer surfaces are important in desalination facilities. From the point of view of current state-of-the-art of manufacturing capability, double fluted tubes are used as the baseline for comparison. The theoretical bases and experimental data for surface enhancement on both the condensing and evaporating sides are described. It is concluded that the mechanism responsible for high performance on the condensing side of fluted or finned tubes is relatively well understood, at least qualitatively. The mechanism on the evaporating side is apparently much more complicated and not at all well understood. Estimates of the upper limits on film coefficients on the condensing side and on the evaporative side indicate that an upper limit on the overall coefficient for enhanced surfaces, as they presently are conceived, might be as large as 6000 Btu/hr · ft^2 · °F. However, such large values will have little impact on desalination costs unless reliable procedures are developed for reducing the fouling factor to the lower limit of 0.00006 to 0.00008 sometimes observed in practice. (L.C.L.)

25455 (EUR-4761) SPECTRAL ANALYSIS OF PRESSURE SIGNALS OBTAINED DURING RAPID CONDENSATION OF STEAM BUBBLES IN WATER. Hardy, M.; Delaval, M. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 15 Oct 1971. 34p. (In French). Dep. NTIS (U. S. Sales Only). EUR FB 50,-.

In the collapse of vapor bubbles either in direct condensation, cavitation, or in collapse caused by ultrasonic waves, there occurs an energy release which creates shock waves. These produce peaks of pressure which can be important. Different factors influence the amplitude and frequency of these pressure signals and consequently on the rate of collapse of the vapor bubbles. An experimental study to analyze the frequencies of the pressure signals obtained under different conditions is described. A method of detection of boiling and cavitation is being developed. (auth)

25456 (KFK-715) FORTRAN PROGRAM FOR DESIGN OF STEAM GENERATORS. Spilker, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Aug 1971. 99p. (In German). Dep. NTIS (U. S. Sales Only).

A computer program is described for calculating the thermal characteristics of steam generators and reheaters with various primary fluids. The program was developed for use on the Fast Breeder Project and was used to determine the characteristic thermodynamic and geometric design data for heat transfer components of the cooling circuits which are required for preliminary investigations and the preparation of studies. The program was made flexible enough to be applicable in principle to all steam generation systems relevant to reactor plants. To ensure rapid evaluation of results, the computed data may be represented as diagrams simultaneous with computation, in addition to the usual output. The basic structure of the computer program is explained with a simplified block diagram. A detailed description of the applicability of the program, input and output, and a comprehensive explanation of possible false indications are included. In the appendix, the output lists are placed together as tables and diagrams for some examples; moreover, the lists of all computer programs which are necessary to carry out the MAIN program are included. (auth)

25457 (KR-144) THERMAL NON-EQUILIBRIUM AND BUBBLE SIZE DISTRIBUTIONS IN AN UPWARD STEAM WATER FLOW. Sandervag, Oddbjoern (Institutt for Atomenergi, Kjeller (Norway)). Oct 1971. 106p. Dep. NTIS (U. S. Sales Only).

A usual assumption in steam–water flow descriptions is that thermal equilibrium is established without time delay. This may lead to considerable errors under certain circumstances. A basic hypothesis that the two phases are generally not in a thermal equilibrium state is described. An equation for vapor formation is introduced. A correlation for steam production from a heating surface due to bubble growth and detachment is derived. The experiments are performed in an upward, vertical steam–water flow at four pressure levels, ranging from 20 to 49 bar. Significant liquid superheat in fully developed boiling, as well as subcooled void, is observed. Bubble diameter distributions are determined by analysis of the signals from the void probe. Applications of the distributions are indicated. Mass transfer coefficients for the bubble clouds are calculated based on single bubble growth. (auth)

25458 (ORO-3939-8) EXPLANATORY LEAFLET FOR THE FILM "BOILING PROCESS WITH SINE INPUTS: ALL BOILING MODES." Peterson, W. C.; Zaalouk, M. G. (North Carolina State Univ., Raleigh). 30 Sep 1971. Contract AT (40-1)-3939. 5p. Dep. NTIS.

Information is provided which should be useful to those who are to view the motion picture film, "Boiling Process with Sine Inputs—All Boiling Modes." The film is silent, in color, 16 mm, and of fifteen minutes duration. High speed motion pictures show

phenomena in nucleate, transition and film boiling. Effects of variations are shown by means of sine wave inputs. (auth)

25459 (ORO-3939-9) DYNAMICS AND CONTROL OF A HEAT TRANSFER PROCESS. Final Report. Peterson, W. C.; Zaalouk, M. G. [North Carolina State Univ., Raleigh]. [nd]. Contract AT(40-1)-3939. 9p. Dep. NTIS.

A feedback system has been developed which permitted stable operation of a pool boiling heat transfer process over the entire boiling curve. A project was undertaken to develop methods for: measuring process static characteristics which would allow plotting a complete boiling curve; measuring process dynamic characteristics to obtain results which could be compared with analytical characteristics; and analyzing fuel element dynamics for the boiling water reactor. A method for measuring process static characteristics was developed and resulted in data from which it was possible to draw a smooth and complete boiling curve. A method for measuring process dynamic characteristics was developed and used with the following results: in the film boiling region, the experimental data agreed well with analytical data; in the nucleate region, analytical and experimental results did not agree as well as desired; (It appeared that bubble formation in nucleate boiling involved a time delay. When a new analysis was performed taking this time delay into account, the results were in better agreement with the experimental data.), and, in the transition region, it was concluded that the discrepancy between experimental and theoretical results was due entirely to the end effects and that when these are eliminated the results will be in agreement. Some progress was made in developing a method for analyzing fuel element dynamics for the boiling water reactor, but this work is incomplete. (L.C.L.)

25460 METHOD AND APPARATUS FOR THE HEATING OF SPHERES AND OTHER SOLID BODIES. Fiebelmann, Peter; Schuetz, Guenther (to EURATOM). British Patent 1,260,099. 12 Jan 1972. Priority date 25 Aug 1969, Germany.

Spheres, sphere-like members or other solid bodies constructed wholly or partly of substances having good neutron moderating or reflecting properties are heated to supply heat for an endothermal chemical process by being passed through a zone of a nuclear reactor core, which is thermally shielded from the heat generating and cooled fission zone, before the bodies enter the process chamber. Preferably, the spheres are constructed of BeO, graphite, or metal carbides. The bodies may also be coated with corrosion-inhibiting or catalytic layers. The apparatus for carrying out the heating is described. (B.L.M.)

25461 HEAT TRANSFER 1970. VOLUME I. Papers Presented at the Fourth International Heat Transfer Conference, Paris-Versailles 1970. Grigull, Ulrich; Hahne, Erich (eds.). Amsterdam; Elsevier Publishing Company (1970). 321p. (In several languages). (CONF-700805-(Vol.1)).

Forty-four papers on conductive heat transfer and heat exchangers were presented at the conference and are included in this volume. A separate abstract was prepared for each of 6 papers. Thirty-three papers were not within the scope of NSA. (L.C.L.)

For abstracts of individual papers see: 25462–25467.

25462 HEAT CONDUCTION IN ONE-DIMENSIONAL GEOMETRIES WITH NONUNIFORM INTERNAL HEAT GENERATION. Melese-d'Hospital, G. B.; Wilkins, J. E. Jr. (Gulf General Atomic Inc., San Diego, Calif.). pp CU1.3.1-11 of Heat Transfer 1970. Vol. I. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

A comparison is made between maximum temperatures in cases of uniform or nonuniform internal heat generation for the same total heat production, in slabs, cylinders or spheres. The ratio between the relative difference in maximum temperatures (in the nonuniform and uniform cases) and a (dimensionless) measure of the nonuniformity in heat generation is shown to vary between narrow bounds which depend only upon the geometric configuration. When the distribution of heat generation is better known, the bounds on this (variational) ratio get closer together. Similar results were obtained with cylindrical and spherical shells, for maximum or average temperature and with several boundary conditions. (auth) (France)

25463 ANALYSIS OF THE TWO-DIMENSIONAL TEMPERATURE DISTRIBUTION IN ECCENTRICALLY MOUNTED CYLINDERS WITH SPECIAL APPLICATION TO SODIUM-BONDED REACTOR FUEL ELEMENTS. Wolf, Lothar; Johannsen, Klaus. (Technische Univ., Berlin). pp CU1.7.1-11 of Heat Transfer 1970. Vol. I. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

The steady temperature distribution in infinitely long, eccentrically mounted cylinders is analyzed in modified bipolar coordinates. Joining and boundary conditions are of the third kind, and may vary circumferentially. Volumetric heat sources may depend on position. The developed analytical method of solution takes advantage of the orthogonality property of circular harmonics, and establishes by its successive use an infinite set of nonhomogeneous linear equations which after appropriate truncation is solved for the unknown coefficients. As an example, the container-type reactor fuel element is treated. (auth) (France)

25464 HEAT FLOW ACROSS CYLINDRICAL METALLIC JOINTS. Williams, A.; Madhusudana, C. V. (Monash Univ., Clayton, Australia). pp CU3.6.1-11 of Heat Transfer 1970. Vol. I. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Although the mechanism of heat flow across flat metallic contacts has been well explored, the comparable mechanism with cylindrical contacts has received relatively little attention. The basic problems of cylindrical contacts are surveyed, these are compared with flat contacts, and the results of two experimental investigations are reported. The first of these simulated only a part of a cylindrical contact. The second series of tests, on fully cylindrical test specimens having differing degrees of fit, produced predictable results with cylinders having clearance, but were inconclusive with interference fits due to the very low values of contact resistance resulting from the extremely high interface pressures generated. (auth) (France)

25465 EFFECT OF ECCENTRICITY ON EFFECTIVENESS OF A SODIUM-TO-SODIUM, DOUBLE-PIPE, HEAT EXCHANGER. Bump, T. R.; Stein, R. P.; Featherstone, M. J.; Kimont, E. L. (Argonne National Labs., Ill.). pp HE1.1.1-11 of Heat Transfer 1970. Vol. I. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

The effects on overall heat transfer rates of eccentric placement of the inner pipe of a liquid-metal counter-flow double-pipe heat exchanger were determined experimentally. The results show that over the range of operating conditions covered, eccentricity has a small effect on the overall heat transfer and that for most practical engineering design calculations, eccentricity can be ignored. The results show, however, that the effects of eccentricity on circumferential heat flux and temperature distribution are considerable. A procedure for calculating temperature and flux distributions for eccentric operation with equal sodium flow rates on both sides of the exchanger is described and applied to the data of a typical experiment. (auth) (France)

25466 GAS TURBINE REGENERATOR. Malherbe, J.; Lelarge, d'Ervau, G. (CEN, Saclay, France). pp HE1.3.1-11 of Heat Transfer 1970. Vol. I. /Grigull, Ulrich (ed.). Amsterdam ; Elsevier Publishing Co. (1970). (In French).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

A gas turbine regenerator was developed for a direct-cycle nuclear power station. Thermodynamics were used to relate the size of the regenerator to the yield, and to show that the parameters relative to the exchanger construction and pressure drop could be optimized. A comparative study of different types of regenerators enabled the final choice to be directed towards exchangers with smooth small diameter pipes or plate-type exchangers. (auth) (France)

25467 NUMERICAL METHOD FOR SIMULATING THE DYNAMIC AND THERMAL BEHAVIOR OF A COMPRESSIBLE FLUID IN A CLOSED CIRCUIT UNDER VARIABLE OPERATING CONDITIONS. Rousseau, J. C.; Dobremelle, M. (CEN, Saclay, France). pp HE1.4.1-10 of Heat Transfer 1970. Vol. I. /Grigull, Ulrich (ed.). Amsterdam ; Elsevier Publishing Co. (1970). (In French).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

The momentum, continuity, and energy conservation equations are applied to a closed circuit containing a gas flow. The calculation gives the flow rate, pressure, and temperature of this gas and also the temperature of the walls throughout the entire circuit. The method is used to determine the behavior of a gas-cooled nuclear reactor whose exchanger is located below the energy generating core, when the blower is shut down. It is then possible to predict instabilities and flow reversals in the circuit that may prejudice the proper cooling of the station. (auth) (France)

25468 HEAT TRANSFER 1970. VOLUME III. Papers Presented at the Fourth International Heat Transfer Conference, Paris-Versailles 1970. Grigull, Ulrich; Hahne, Erich (eds.). Amsterdam; Elsevier Publishing Company (1970). 294p. (In several languages). (CONF-700805-(Vol.3)).

Fifty-two papers on forced convection and radiant heat transfer were presented at the conference and are included in this volume. A separate abstract was prepared for each of 11 papers. Forty-one papers were not within the scope of NSA. (L.C.L.)

For abstracts of individual papers see: 25469–25478 and 26452.

25469 DEVELOPMENT OF IMPROVED HEAT TRANSFER SURFACES FOR TUBES IN CROSS-FLOW, USING A LARGE SCALE MODEL TECHNIQUE. Neal, S. B. H. C.; Hitchcock, J. A. (Central Electricity Research Labs., Leatherhead, Eng.). pp FC7.8.1-11 of Heat Transfer 1970. Vol. III. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Detailed heat transfer and air flow measurements were made on plain and finned tubes in cross-flow in order to gain an understanding of the main factors influencing heat transfer. This knowledge led to the development of an improved surface for heat transfer in the form of discrete rib roughnesses integral with the base tube. This surface could have important application in the heat exchangers of nuclear power stations of the Advanced Gas Cooled Reactor (A.G.R.) and High Temperature Reactor (H.T.R.) types. The surface offers an improvement in heat transfer over a plain tube of over 40% for a similar tube pitch. (auth) (France)

25470 HEAT TRANSFER TO MERCURY FLOWING IN-LINE THROUGH AN UNBAFFLED ROD BUNDLE: EFFECT OF ROD DISPLACEMENT ON LOCAL SURFACE TEMPERATURE AND LOCAL HEAT FLUX. Dwyer, O. E.; Hlavac, P. J.; Helfant, M. A. (Brookhaven National Lab., Upton, N. Y.). pp FC7.9.1-12 of Heat Transfer 1970. Vol. III. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

The effects of extent and direction of displacement of a rod on its peripherally local surface temperature, local heat flux, local heat transfer coefficient, and local surface temperature fluctuations are reported. The rods were electrical-resistance heaters, consisting of a coiled Nichrome resistor surrounded by compacted MgO and encased in a metal cladding. It was found that displacement of a rod can cause large variations in its local heat transfer characteristics. Aside from pitch: diameter ratio, the main independent parameters affecting these characteristics are: circumferential angle (θ), average heat flux ($\bar{q}_2$), relative cladding thickness $[(r_2-r_1)/r_2]$, relative cladding conductivity (k_w/k_f), and flow rate (Pe). For a given displacement, the magnitudes of the circumferential variations in local temperature and heat flux are influenced most by the extent of relative displacement (σ), and least by changes in $(r_2-r_1)/r_2$ and k_w/k_f. (auth) (France)

25471 HEAT TRANSFER BETWEEN SUBCHANNELS IN A ROD BUNDLE. Ingesson, Lars; Hedberg, Stellan (Aktiebolaget Atomenergi, Studsvik, Sweden). pp FC7.11.1-11 of Heat Transfer 1970. Vol. III. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

In designing fuel elements for nuclear reactors it is important to know the intersubchannel mixing. The mixing reduces the temperature differences in the fluid and makes it possible to increase the power for a given maximum surface temperature. Several methods for prediction of mixing have been proposed but none of them seem to work for a general case. An experimental investigation was made in which two configurations with pitch-to-dia ratios of 1.62 and 1.1 respectively were tested. On the basis of these experiments and other available data, it was possible to develop a calculation method which could predict mixing with reasonable accuracy for various channel geometries. (auth) (France)

25472 HEAT TRANSFER IN FINNED ROD CLUSTERS WITH AXIAL FLOW. Krett, Vasil (Skoda Works, Plzen, Czech.). pp FC7.12.1-12 of Heat Transfer 1970. Vol. III. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

An account of the experimental equipment, methods of measurement and evaluation of the friction coefficient and the heat transfer coefficient on bundles of finned rods is given. Taking the conceptional possibilities of the HWGCR fuel elements into account the following two types of finned rods were used: the first type with 3 higher fins without any spacers and the second type with 12 and 15 lower fins with spacers. The results of measurements are given in nondimensional criteria dependent on geometrical characteristics of the bundles. The experiments were carried out with air in the range of $Re = 0.4 \times 10^5$ to 2×10^5. (auth) (France)

25473 THERMAL-HYDRAULIC SUBCHANNEL ANALYSIS FOR ROD BUNDLE NUCLEAR FUEL ELEMENTS. Rowe, D. S. (Battelle-Northwest, Richland, Wash.). pp FC7.13.1-11 of Heat Transfer 1970. Vol. III. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

A method for calculating the flow and enthalpy in the subchannels of rod bundles of reactor fuel elements is presented. The method uses a mathematical model that considers the effect of cross flow mixing between the flow subchannels. The model equations are solved by using finite differences and by supplying the turbulent component of cross flow mixing. The validity of the method is shown by using experimental values of turbulent cross flow as input to calculations that successfully predict the flow and enthalpy obtained in an independent experiment. (auth) (France)

25474 INVESTIGATION OF TURBULENT TEMPERATURE AND PRESSURE PULSATIONS IN ROD BUNDLES WITH LONGITUDINAL FLOW. Kadlec, J.; Lang, W. (Kernforschungszentrum, Karlsruhe, Ger.). pp FC9.3.1-11 of Heat Transfer 1970. Vol. III. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970). (In German).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

The pressure and temperature pulsations in the coolant were studied as stationary stochastic processes. The experimental facilities, the equipment for recording and preparing the measured data for digital stochastic analysis, and the preliminary results of the measurements are explained. The spectrum density functions for the pressure and temperature pulsations are represented graphically. (auth) (France)

25475 THERMAL-ENTRY REGION HEAT TRANSFER IN MAGNETOHYDRODYNAMIC CHANNEL FLOW SUBJECT TO AXIAL CONDUCTION AND THE BOUNDARY CONDITION OF THE THIRD KIND. Hsu, Chia-jung; Lindauer, George C. (Brookhaven National Lab., Upton , N. Y.). pp FC9.6.1-12 of Heat Transfer 1970. Vol. III. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Thermal-entry region heat transfer in an MHD channel was studied for the boundary condition of the third kind considering Joule heating, viscous dissipation and axial conduction. To allow for the effect of axial conduction at $x = 0$, the fluid temperature was taken to be uniform at $x = -\infty$, and the first 20 eigenconstants were computed for the regions $x \leq 0$ and $x \geq 0$, separately. Both the temperatures and temperature gradients were matched at $x = 0$ by constructing a pair of orthonormal functions from the nonorthogonal eigenfunctions. From the temperature solutions, the effects of Hartmann number, electric field factor, radiation, and heat generation parameters as well as Peclet number on the local Nusselt number were examined. (auth) (France)

25476 HEAT TRANSFER IN ALIGNED-FIELD MAGNETOHYDRODYNAMICS. Tan, C. W. (Cooper Union for the Advancement of Science and Art, New York). pp FC9.8.1-10 of Heat Transfer 1970. Vol. III. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

The general problem of steady, laminar flow of a viscous, incompressible, electrically conducting fluid of constant properties past a semi-infinite flat plate is considered. The applied magnetic field and free-stream velocity are uniform and parallel to the plate. The assumption on the electric field is lessened from the already established Greenspan–Carrier problem of zero electric field to include other physically realizable problems having arbitrary total currents within the boundary layer. Comparisons are made between the short-circuit and open-circuit conditions in terms of skin friction, current density at the plate surface, and heat transfer characteristics for both a thermally-insulated and a uniform-temperature plate. (auth) (France)

25477 MAGNETIC FIELD EFFECT ON HEAT TRANSFER FOR HARTMANN'S FLOW IN THERMAL CONDUCTIVE LIQUID. Trusov, V. P.; Teplov, S. V. (Power Engineering Inst., Moscow). pp FC9.9.1-11 of Heat Transfer 1970. Vol. III. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Heat transfer by laminar flow in a rectangular canal in a transversed magnetic field was studied. The variational Ritz method is used to solve a number of boundary problems. The magnetic field effect on both the inlet temperature distribution curve and on stabilized heat transfer is proved. The part played by axial thermal conductivity and inner heat sources in heat transfer of liquids within a magnetic field is established. (auth) (France)

25478 CONVECTIVE AND RADIATIVE HEAT TRANSFER TO WATER VAPOR IN UNIFORMLY HEATED TUBES. Larsen, P. S. (Michigan Univ., Ann Arbor); Lord, H. A.; Farman, R. F. pp R2.6.1-10 of Heat Transfer 1970. Vol. III. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Total heat transfer by radiation and turbulent convection to water vapor was measured along 915 mm long by 12.7 mm ID uniformly heated tubes. Parameter ranges were: pressure (1.7, 3.4, 5.1 atm), inlet temperature (150, 370, 595°C), bulk inlet Reynolds number (1900 to 35,000), wall temperature (200 to 1100°C), and wall-to-bulk temperature ratio (1.1 to 2.11). Superposition of convective and radiative heat transfer in fully turbulent flow is shown to be valid in the thin gas limit. A closed form expression for the radiative transfer accounting for real gas properties is in substantial agreement with experiment. Data of intermediate optical thickness is correlated empirically. (auth) (France)

25479 PROPOSED METHOD OF MEASURING THERMAL DIFFUSIVITY OF A SMALL SPECIMEN AT INCANDESCENT TEMPERATURES. Kumada, Toshiaki (Hokkaido Univ., Sapporo); Kobayasi, Kiyosi. J. Nucl. Sci. Technol. (Tokyo); 9: No. 3, 192-4(Mar 1972).

A method for determining thermal diffusivity using an electron beam is described. The method has the advantages of easy stepwise electron beam modulation, short measuring time, and absence of radiative heat transfer from the lateral face of the test specimen. (J.R.D.)

25480 HEAT TRANSFER 1970. VOLUME V. Papers Presented at the Fourth International Heat Transfer Conference, Paris-Versailles 1970. Grigull, Ulrich; Hahne, Erich (eds.). Amsterdam; Elsevier Publishing Company (1970). 306p. (In several languages). (CONF-700805-(Vol.5)).

Fifty-seven papers on heat transfer and the phenomena of nucleate, transition, film, and flow boiling were presented at the conference and are included in this volume. A separate abstract was prepared for each of 13 papers. Forty-four were not within the scope of NSA. (L.C.L.)

For abstracts of individual papers see: 25481–25493.

25481 EFFECT OF THE DISSOLVED GAS CONTENT UPON INCIPIENT BOILING SUPERHEATS. Torikai, Kinichi; Shimamune, Hiroji; Fujishiro, Toshio (Japan Atomic Energy Research Inst., Tokai). pp B2.11.1-10 of Heat Transfer 1970. Vol. V. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

The effect of dissolved gas on the incipient boiling superheat was obtained with electrically heated wires (0.05 and 0.1 mm-dia) immersed in water under reduced pressure conditions (0.05 to 1.0 bar). The dissolved air content in water was fixed by boiling deaeration (0 to 4 ppM) and was measured by Winkler's method. The surface temperature of the wire was determined by its electric resistance. The experimental results demonstrate the effect of the dissolved gas content and agree very well with calculated curves, even though the data showed some dispersion. (auth) (France)

25482 TRANSIENT BOILING HEAT TRANSFER. Johnson, H. A. (Univ. of California, Berkeley). pp B3.1.1-11 of Heat Transfer 1970. Vol. V. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Experimental transient boiling heat transfer in water for exponential heat inputs to thin metallic ribbons of $0.015 \times 10^6\ e^{t/\tau_0}$ Btu/ft^{2}hr are compared with steady state predictions. The nominal values of controlled variables included velocity: ≤1 and 14 ft/s; pressure: 14.7, 500, 1000, and 2000 psia; subcooling: ≤10, 42, and 112°F; exponential period: 5, 15, and 50 milliseconds. (auth)

25483 HEAT TRANSFER AND DNB HEAT FLUX IN TRANSIENT BOILING. Kawamura, Hiroshi; Tachibana, Fujio; Akiyama, Mamoru (Tokyo Univ.). pp B3.3.1-11 of Heat Transfer 1970. Vol. V. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Test pieces of different thickness were heated by electric current with various power functions. Pool and flow boilings of water were studied at atmospheric pressure. In subcooled boiling, the heat transfer rate is fairly high even after the DNB (Departure from Nucleate Boiling) point. DNB heat flux increases up to a saturation value with increasing test piece thickness. When power has maintained a non-zero level before the transient starts, the DNB heat flux is considerably reduced. A model analysis of transient saturated pool boiling is developed. The calculated results are compared with experimental data. (auth)

25484 POST BURNOUT HEAT TRANSFER AND THERMODYNAMIC DISEQUILIBRIUM UP TO THE CRITICAL PRESSURE. Cumo, M.; Farello, G. E.; Ferrari, G. (CNEN, Rome). pp B3.5.1-13 of Heat Transfer 1970. Vol. V. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Experimental results are given about the heat transfer coefficient for Freon-12 in post-burnout conditions up to the critical pressure in tubular uniformly heated ducts. The heat transfer coefficient and degree of superheating were systematically tested against various leading parameters like vapor quality, mass flow-rate and reduced pressure. The results concerning once-through heat exchangers such as steam generators in sodium-cooled fast reactor plants are presented. (auth) (France)

25485 SIMILARITY AND CURVATURE EFFECTS IN POOL FILM BOILING. Hendricks, Robert C.; Baumeister, Kenneth J. (Lewis Research Center, Cleveland). pp B3.7.1-12 of Heat Transfer 1970. Vol. V. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Cooldown film-boiling-heat transfer data from small diameter spheres (0.0397 to 1.27 cm) are presented, and the effects of curvature and similarities of the theoretical analyses for the flat plate, cylinder, and sphere are assessed. The data are in good agreement with theory but are significantly higher than predicted from the classic Bromley equation. (auth) (France)

25486 LOCAL VARIATIONS OF HEAT TRANSFER IN A HORIZONTAL STEAM EVAPORATOR TUBE. Lis, J. (Central Electricity Research Labs., Leatherhead, Eng.); Strickland, J. A. pp B4.6.1-12 of Heat Transfer 1970. Vol. V. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Detailed measurements have been carried out of the circumferential and longitudinal temperature distribution on the outside wall of a horizontal steam evaporator tube operating at pressures up to 66.5 bars and over a wide range of water/steam mass flow velocities, steam qualities and heat fluxes. The examined inlet geometries to the evaporator tube included a long hydrodynamic calming section and two 180° bends of different radii placed either in the vertical or horizontal plane. With the inlet bend placed in the vertical plane, large amplitude temperature oscillations and "dry wall" patches were observed to develop along the top of the evaporator tube for a wide range of operating conditions. Parameters affecting the development and spread of these disturbances along the top of the tube are analyzed and discussed. (auth)

25487 PRESSURE DROP AND HEAT TRANSFER FOR FLOW OF BOILING WATER IN VERTICAL ROD BUNDLES. Osmachkin, V. S.; Borisov, V. D. (Inst. of Atomic Energy, Moscow). pp B4.9.1-11 of Heat Transfer 1970. Vol. V. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Pressure drop and heat transfer for upflow of boiling water in vertical multi-rod bundles are analyzed. The rod bundle is considered as a system of parallel interacting subchannels. In the technique proposed the void formation over subcooled boiling region is taken into account as well as the nonsimilarity of the subchannel and tube geometries. A short description of the 6 MW rig and some experimental results from the 19-rod bundle are given. (auth) (France)

25488 VOID FRACTION AND PRESSURE DROP IN SUBCOOLED FLOW BOILING. Staub, F. W.; Walmet, G. E. (General Electric Co., Schenectady, N. Y.). pp B4.11.1-12 of Heat Transfer 1970. Vol. V. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

A method for predicting the void fraction in subcooled flow boiling is summarized and extended to include the prediction of the pressure drop in the subcooled region. Experimental measurements of the local void fraction, liquid phase temperature, and velocity profiles in low-pressure water flowing vertically upward are presented and employed to validate the suggested analytical model. Further void fraction and pressure drop measurements up to reduced pressures of 0.7 in both Refrigerant-22 and water are also satisfactorily compared with the predicted values. The effect of pH and reactivity control additives on the void fraction and the presence of transverse static pressure profiles are indicated. (auth)

25489 EFFECT OF HELICAL-FLOW INSERTS ON BOILING PRESSURE DROP. Stone, James R. (Lewis Research Center, Cleveland). pp B5.1.1-9 of Heat Transfer 1970. Vol. V. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

The effect of helical-flow-promoting inserts on boiling pressure drop is correlated for water and alkali metals at relatively low pressures. A constant-slip model is used. The slip ratio (mean gas velocity divided by mean liquid velocity) is approximated by the square root of the liquid-to-gas density ratio. For boilers with no inserts, the two-phase friction factor has previously been correlated as a function of mean superficial liquid and gas Reynolds numbers. It is assumed that inserts affect pressure drop through an increase in friction factor and reduction in flow area. The two-phase friction factor is correlated herein as a function of mean superficial liquid and gas Reynolds numbers and the ratio of insert pitch to tube diameter. (auth) (France)

25490 STUDY OF MIST COOLING: THERMAL BEHAVIORS OF LIQUID FILMS FORMED FROM MIST DROPS ON A HEATED SURFACE AT HIGH TEMPERATURES AND HIGH HEAT FLUXES. Toda, Saburo (Japan Atomic Energy Research Inst., Tokai); Uchida, Hideo. pp B5.3.1-11 of Heat Transfer 1970. Vol. V. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Heat transfer phenomena of mist cooling by water mist drops sprayed vertically on a heated surface are classified into low temperature, transitional, and high temperature regions according to the thermal behaviors of the liquid films formed from mist drops. These behaviors are simplified as an evaporating state from liquid film (E-state) and a film-boiling-like state (F-state). Every liquid film necessarily appears either in E-or in F-state with probability e_E or e_F. Thus, mist cooling is determined as the probability phenomenon. (auth) (France)

25491 MODELLING OF TWO-PHASE LIQUID-VAPOR FLOWS WITH HEAT TRANSFER. Boure, J. A. (CEA, Grenoble, France). pp B5.6.1-10 of Heat Transfer 1970. Vol. V. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970). (In French).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

The classical methods of dimensional analysis do not permit the development of scaling laws for systems, such as two-phase flows, depending on numerous parameters. Since such laws are of considerable practical interest, a method is proposed for their development. This method is applied to two-phase liquid vapor flows with heat transfer. In the case of burnout, the laws found are tested, using experimental results. A satisfactory model is possible. (auth) (France)

25492 TWO-PHASE HEAT TRANSFER AND FLOODING IN COUNTER CURRENT FLOW. Frea, W. J. (Michigan Technological Univ., Houghton). pp B5.10.1-11 of Heat Transfer 1970. Vol. V. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Experimental data for two-phase heat transfer in small vertical tubes closed at the bottom and open to a liquid reservoir at the top (the open thermosyphon) with vapor-liquid counter current flow under gravities from 0.1 to 100 times earth gravity were obtained. Gravities less than 1.0 times earth were simulated by tilting the tubes from the vertical and gravities greater than 1.0 simulated in a centrifuge. Critical heat flow rates and convection coefficients are presented. Results are correlated based on dimensionless parameters obtained from analysis of an annular flow model. (auth)

25493 TWO-PHASE HEAT EXCHANGE IN VERTICAL OR HORIZONTAL TUBES. Ricque, R.; Roumy, R. (CEA, Grenoble, France). pp B5.12.1-11 of Heat Transfer 1970. Vol. V. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970). (In French).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Experimental results are presented for two-phase heat transfer with Freon-12 in heated tubes. Preliminary tests were first made with vertical tubes to assess the importance of the effects due to an elbow. Then, with horizontal tubes preceded by an elbow, the conditions of critical dryout of the liquid film in annular flow, and of the heat exchange in dispersed flow, were defined. (auth) (France)

For abstracts of individual papers see: 25495–25499.

25494 HEAT TRANSFER 1970. VOLUME VII. Papers Presented at the Fourth International Heat Transfer Conference, Paris-Versailles 1970. Grigull, Ulrich; Hahne, Erich (eds.). Amsterdam; Elsevier Publishing Company (1970). 284p. (In several languages). (CONF-700805-(Vol.7)).

Forty-six papers on combined heat transfer and methods for measuring heat transfer were presented at the conference and are included in this volume. A separate abstract was prepared for each of five. Forty-one papers were not within the scope of NSA. (L.C.L.)

25495 HEAT TRANSFER AND FLOW CHARACTERISTICS IN CONDUCTIVE POROUS MEDIA WITH ENERGY GENERATION. Choudhury, W. U.; El-Wakil, M. M. (Univ. of Wisconsin, Madison). pp CT3.2.1-12 of Heat Transfer 1970. Vol. VII. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Heat transfer and fluid flow in porous media with finite solid and fluid thermal conductivities and energy generation were investigated. Two coupled transient linear equations were solved by an implicit numerical modified Crank–Nicholson method. Single blow fluid temperature history and friction factors were measured. Energy was generated electrically. A volumetric heat transfer coefficient was obtained by matching experimental and analytical data. Correlations were based on a characteristic length obtained from pressure drop. The solid and fluid thermal conductivities have appreciable effects upon their respective temperatures but little effect on that of the other. (France)

25496 HEAT TRANSFER FROM CYLINDERS EMBEDDED IN A LIQUID FILLED POROUS MEDIUM. Schrock, V. E.; Fernandez, R. T.; Kesavan, K. (Univ. of California, Berkeley). pp CT3.6.1-11 of Heat Transfer 1970. Vol. VII. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Heat transfer from a cylinder embedded in a porous medium that is saturated with liquid has been studied experimentally and analytically for the case where the porous medium is essentially semi-infinite with a horizontal surface under a free liquid region. When the permeability is low and the heat rate is low (low Grashof-Prandtl product) the heat is transferred entirely by conduction. At a Grashof-Prandtl number of 10^{-2} convection begins to play a role. A correlation has been developed for the heat transfer in the convection region. When the heat rate is increased the surface temperature eventually reaches the saturation temperature and subcooled boiling commences. (auth)

25497 THEORY AND APPLICATION OF THE PARALLEL AND DIVERGING RADIATION BEAM METHOD IN TWO-PHASE SYSTEMS. Kondic, N. N.; Hahn, O. J. (Univ. of Kentucky, Lexington). pp MT1.5.1-10 of Heat Transfer 1970. Vol. VII. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Two-phase systems are an important part of heat transfer research. If a system is penetrated by waves (radiation, sound, nuclear particles, etc.) the average value of concentration along the beam is registered. It is advantageous to measure the concentration field along the beam itself with the instrumentation outside the system, independent of field variations in other directions. Two such methods are proposed. The results of one of them are experimentally verified. (auth)

25498 MEASUREMENT OF EDDY DIFFUSIVITY OF HEAT IN SODIUM. Sheriff, N.; O'Kane, D. J.; Mather, B. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp MT2.5.1-10 of Heat Transfer 1970. Vol. VII. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

Measurements were made of the eddy diffusivity of heat in a circular pipe with turbulent sodium flow. For this type of experiment a new technique was used, in which a source of heat is injected into the central region of the pipe. From measurements of the temperature distribution in the sodium flow downstream of the injector position, the total effective thermal diffusivity is evaluated. At a Reynolds number of 8×10^4 the eddy contribution to the total thermal diffusivity was found to be such that ϵ_H/α varied between 0.7 and 0.8. (France)

25499 MEASURING THE HEAT TRANSFER PERFORMANCE OF NUCLEAR REACTOR FUEL ELEMENT CLUSTERS USING THE TECHNIQUE OF SUPERPOSITION OF TEMPERATURE DISTRIBUTIONS. Mantle, P. L.; Morss, A. G. (Central Electricity Generating Board, Gloucestershire, Eng.). pp MT2,7.1-12 of Heat Transfer 1970. Vol. VII. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970).

From fourth international heat transfer, conference; Paris-Versailles, France (31 Aug 1970).

It is shown how the heat transfer performance of a channel of Advanced Gas Cooled Reactor (A.G.R.) 36-pin fuel clusters can be determined by heating only six of the pins in each cluster. The experiments are run in such a way that the temperature distributions can be superposed. The experimental results are processed by computer to yield the mean heat transfer performance and other more detailed information which this method gives. For instance the pin temperatures in the cluster are readily obtained for any heat flux distribution. The technique is used to compare the performance of a transverse ribbed cluster with one containing pins having helical ribs. The improved heat transfer performance and the advantages of gas mixing promoted by the helical ribbing are demonstrated. (France)

25500 OBSERVATION OF SODIUM BOILING PHENOMENA BY DIRECT HEATING IN FORCED CONVECTION LOOP. Takahashi, Katsuro; Fujii-e, Yoichi; Suita, Tokuo (Osaka Univ.). Technol. Rep. Osaka Univ.; 21: 627-46(Oct 1971).

Results of a preliminary investigation on sodium boiling with upward forced convection loop are presented. Forced convection sodium in a vertical tube of 14.9 mm inner diameter is directly heated by direct current (~3V, ~5000A). The velocity of the interface between vapor and liquid during ejection and reentry, and also the thickness of residual sodium on the wall were measured using an electrical method. The two-phase flow patterns during continuous boiling were observed. The ejector velocities were ranged from 1.0 to 12.5m/s. The reentry velocities measured were from 1.0 to 2.5m/s, and the thickness of the sodium film from 0.01 to 0.7mm. (auth)

25501 MEASUREMENTS OF THERMAL RADIATION SCATTERING CHARACTERISTICS OF SUBMICRON REFRACTORY PARTICLES. Jacobs, William Reid Jr. Atlanta; Georgia Inst. of Tech. (1971). 180p. University Microfilms Order No. 72-5051.

Thesis.

There is growing interest in the seeding of gases with small refractory particles to increase the ability of the gas to attenuate or absorb thermal radiation. The two parameters of interest for calculational purposes are the extinction parameter and the differential scattering parameter. Previous work at the Georgia Institute of Technology has been concerned with measuring the extinction parameter of submicron tungsten and carbon particles in hydrogen. The differential scattering parameter has been measured for 0.04 micron tungsten particles in hydrogen and nitrogen at temperatures to 1088°K. The differential scattering parameter has also been measured for 0.1 micron tungsten, three types of carbon particles, and fly ash in nitrogen at temperatures to 1000°K. By integrating the differential scattering parameter over 4π steradians, the total scattering parameter may be evaluated. The 0.04 micron tungsten shows a temperature dependent total scattering parameter varying from around 4,000 cm^2/gm at room temperature to 7,000 cm^2/gm at 1088°K. The temperatures over which data were taken are not high enough to confirm the temperature dependence of the total scattering parameter of tungsten. An increase in extinction parameter at higher temperatures has been noticed by other investigators. The total scattering parameter for carbon was essentially independent of temperature and had a value of approximately 25,000 cm^2/gm. The measurements agree quite well with the Mie theory calculations for particles in the 0.2 to 1.0 micron radius range. The actual particle agglomerates fall in this size range. (Diss. Abstr. Int., B)

25502 ULTRASONIC VELOCITY OF SOUND AND VOID FRACTION IN A BUBBLY MIXTURE. Card, D. C. (Atomic Energy of Canada, Ltd., Pinawa, Manitoba); Sims, G. E.; Chant, R. E. J. Basic Eng.; 93: No. 4, 619-23(Dec 1971).

The velocity of sound at a frequency much greater than resonance in a bubbly air–water mixture has been measured for varying void fractions in a "pool" system. Only measurements of acoustic velocity well below resonance for varying void fractions, or near resonance for a few low void fractions, were previously available. The results presented show marked differences in the velocity of sound at high frequency (500 kHz) compared with existing low-frequency data. Existing theory, for low void fractions, is discussed in relation to phase, group, and signal velocity, with the limitations at high void fractions being given. The application of the technique for determining void fractions in two-phase flow systems is discussed. (auth)

Materials Testing

Refer also to abstracts 25448 and 25949.

25503 (CNLM-5555) SNAP-50/SPUR PUMP MATERIAL TEST REQUIREMENTS. Milich, J. J. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 25 Feb 1964. Contract AT(30-1)-2789. 3p. Dep. NTIS.

Declassified 5 Nov 1971.

The test requirements include those for short-time tensile tests, creep tests, and stress-to-rupture tests. (J.R.D.)

25504 (UCRL-Trans-10592) DETAILED STUDY OF THE CEMENT COLLAR BEHIND AN OIL-WELL CASING BY THE SCATTERED-GAMMA-RADIATION METHOD. Bernshtein, D. A. Translated for Univ. of California, Lawrence Livermore Lab., Livermore, from Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.; No. 7, 163-78(1969). 21p. Dep. NTIS.

A scattered-gamma-radiation defectometer has been tried in a number of wells of various diameters with various casings, in a state of overhaul, both along the whole section and over the productive part. The borehole test results show that the defectometer is universal, i.e., measurements can either be taken continuously along the shaft or at various points in selected intervals. The defectograms are much more differentiated than gamma attenuation cementograms, because of the better collimation of the source and the recorded radiation and because the defectogram continuously shows maximum and minimum readings of scattered gamma radiation along the well perimeter. Curves recorded with the defectometer in one and the same well are much more reproducible than cementograms, since in work with the defectometer a very high count rate (mean about 70,000 pulses/min) can be attained and the whole well perimeter is investigated during measurements. Therefore the configuration of the defectogram does not depend on the azimuthal position of the instrument within the well. The presence of one measuring channel simplifies the instrument's operation and increases its reliability. The main advantage of its use is the considerable reduction of measurement errors due to nonidentity of channels, their lack of stability with time, and differences in linearity and sensitivity. The main advantage of the defectometer is the possibility of obtaining $I_{\gamma\gamma} = f(\varphi)$ curves, from the character of which one may assess the state of the material in the annular space. (J.R.D.)

25505 IMPROVEMENTS IN OR RELATING TO METHODS AND APPARATUS FOR EVALUATING METAL CLEANLINESS. (to Allegheny Ludlum Industries Inc.). British Patent 1,269,845. 6 Apr 1972. Priority date 22 Nov 1968, United States.

A method and apparatus for testing material for discontinuities in its structure are described. The sample is bombarded by sonic energy in a controlled pattern and the reflected energy is analyzed by relating it to sample locations. The method and apparatus are primarily related to defects in steel. (J.R.D.)

25506 OPTIMUM DEFECTOSCOPE PARAMETERS WITH ANALOG PROCESSING OF INFORMATION. Pokrovskii, A. V.; Ripp, A. G. (Tomsk Polytechnic Inst., USSR). Defektoskopiya; No. 3, 105-11(1971). (In Russian).

The choice of the basic parameters of a gamma defectoscope is unavoidably linked with the activity level of the radiation source. A method for choosing such parameters for the analog processing of information is presented, and the optimum parameters of a defectoscope, allowing for equipment errors, differ from these recommended in the literature and should be accordingly corrected. (tr-auth)

25507 PARAMETERS OF A BREMSSTRAHLUNG BEAM FROM AN ACCELERATOR FOR A RADIATION DEFECTOSCOPE. Gorbunov, V. I.; Pokrovskii, A. V.; Moroz, P. S. (Tomsk Polytechnic Inst., USSR). Defektoskopiya; No. 3, 117-23(1971). (In Russian).

Basic criteria for estimating the technical and economic effectiveness of various types of accelerators in defectoscopes are presented: betatrons, microtrons, and linear accelerators are compared. A choice of optimum parameters for a beam of bremsstrahlung and accelerator type is made for radiography. (tr-auth)

Nuclear Explosions

Refer also to abstracts 25440, 25564, and 25565.

25508 (EERO-TR-22) FALLOUT PREDICTION PROCEDURE FOR SUBSURFACE ADM'S. Snell, Charles; Burton, Donald; O'Connor, John (Army Engineer Explosive Excavation Research Office, Livermore, Calif.). Sep 1971. 109p.

Simplified and detailed methods are presented for predicting exposure rates due to fallout from underground nuclear detonations. The simplified method, which is performed by hand calculations, is used to predict rough or generalized exposure rate contours in the upwind-crosswind and downwind areas. The detailed method, which can be accomplished by either a hand calculational procedure or a nomogram procedure, is used to predict generalized exposure rate contours in the upwind-crosswind area and detailed exposure rate contours in the downwind fallout area. All procedures are based on a graphic-numerical scaling model. The quantity predicted by use of these procedures is the (H + 1) hour exposure rate, in R/hr. Time dependent exposure rates, total radiation doses, and the Army-defined hazard zones (Zone I, Ia, and II) boundaries may also be predicted if desired. The scaling model prediction methods offer the great advantage of predicting exposure rates from the boundary of continuous material ejected by the explosion out to exposure rates on the order of 0.01 R/hr. The methods are valid for detonations at a wide range of depths of burst. Unusual atmospheric or emplacement conditions may reduce the reliability of the results, but approximate techniques are suggested for performing predictions under certain unusual conditions. (auth)

25509 (NP-19253) PRELIMINARY FEASIBILITY STUDY FOR A NUCLEAR IN SITU OIL SHALE EXPERIMENT IN THE AREA OF THE WOSCO EX-1 WELL, UINTAH COUNTY, UTAH. (Geonuclear Corp., Las Vegas, Nev.). [1969]. 186p.

Analysis of the data shows that a 5 to 10 kiloton (kt) device will be safely contained when detonated at a working point (WP) of 2,360 feet rotary bushing (RB). This explosion should not fracture into any water zone and should produce a chimney with a height of from 200 feet to 455 feet and a radius of from 60 feet to 91 feet in an oil shale sequence having an average oil shale content of approximately 14 to 18 gal/ton. Previous Bureau of Mines results with surface retorts indicate that the lower several hundred feet of the chimney will be retortable. The WOSCO EX-1 site appears to be acceptable from a ground motion and structural response, public health, and hydrologic standpoint. However, the United States Geological Survey (USGS) suggests that some additional tests might be necessary to verify the hydrologic conditions The successful economic development of this oil shale resource utilizing nuclear explosives would necessitate retorting the fractured zone adjacent to the chimney. This would require processing 15 gal/ton shale. The Bureau of Mines has not experimented with shale in this range, in their N.T.U. Retort, however, the Bureau of Mines Laramie Station plans to initiate a series of runs on 12 to 16 gal/ton shale early in 1970. (auth)

25510 MULTISTORY BUILDING RESPONSE DETERMINED FROM GROUND-VELOCITY RECORDS. Douglas, Bruce M.; Weir, Paul (Univ. of Nevada, Reno. Toft and De Nevers Consulting Structural Engineers, San Francisco). Bull. Seismol. Soc. Amer.; 62: No. 1, 357-67(Feb 1972).

Basement- and roof-level velocity records were obtained in a 22-story reinforced concrete building in Reno, Nevada, for the nuclear event FAULTLESS. Analysis of these records indicates that the fundamental period of the building in the E–W direction for small excitations is 1.79 sec. Response calculations were made from an accelerogram, which was produced from the digitized basement-velocity record by filtering out the high-frequency noise and numerically differentiating the filtered result. Also, the equations of motion were recast in terms of absolute motion so that the response of the structure could be obtained by using a linear combination of the ground-velocity and displacement records as the forcing function. The ground displacement used in this treatment was obtained by integration of the velocity trace, corrected for baseline errors. These two methods gave virtually identical results and agree well with the measured roof motion. (auth)

25511 LONG-PERIOD BODY-WAVE PROPAGATION FROM 4^0 TO 13^0. Helmberger, Donald V. (California Inst. of Tech., Pasadena). Bull. Seismol. Soc. Amer.; 62: No. 1, 325-41(Feb 1972).

Numerical seismograms are computed for a compressional pulse in a layered model. The simpler models consist of a fluid layer over a fluid half-space, a fluid layer over a solid half-space, and a solid layer over a solid half-space. Restricted portions of the theoretical response for a layered model approximating the Earth are constructed. Synthetic seismograms are generated using the pressure pulse appropriate for NTS events and the long-period instrument response. The interplay between the PL wave, the refracted wave along the lid, and the arrival from the base of the low-velocity zone is displayed. A detailed comparison between the synthetics and observations indicates a prominent low-velocity zone with appreciable seismic absorption. Observed regional wave-shape characteristics are displayed and a reconnaissance map of lateral variations along the top of the mantle presented. (auth)

Detection Systems

25512 (NP-19237) SEISMIC METHODS FOR MONITORING UNDERGROUND EXPLOSIONS. 1971 Progress Report. Davies, David (Stockholm International Peace Research Inst. (Sweden)). Sep 1971. 29p. Dep. NTIS (U. S. Sales Only).

The discriminant based on the relative excitation of surface waves and body waves by earthquakes and explosions has continued to be the most successful means of identifying events. Explosions are found to generate significantly less surface waves than earthquakes for a given excitation of body waves. Using this technique, it is possible to make three distinct statements about seismic discrimination capability on a global basis. With the currently deployed instruments one can identify, as such, almost every earthquake in Eurasia that is reported by a standard agency (United States Coast and Geodetic Survey). One can also identify explosions from known test sites if they are equivalent to an explosion with a yield of 20 kilotons or more in hard rock. Major instrumental developments now being applied with new deployment of instruments are likely to lower this explosion threshold to 10 kilotons in hard rock. Results from studies of explosions and earthquakes in the Western United States indicate that a lower threshold could be attained everywhere in the future. There are sufficient differences between explosions and earthquakes to show that explosions with yields as low as 2 kilotons in hard rock can probably be identified with improved definitions of discrimination parameters. This result, while valid for the Western U. S. and existing test sites, needs verification to be applied to other regions. If verification is obtained, the establishment of this capability on a global basis will require substantial investment in an improved network. (auth) (Sweden)

25513 ESTIMATION OF THE ELAPSED TIME AFTER NUCLEAR EXPLOSION BY THE ACTIVITY RATIO OF ^{95}Zr TO ^{95}Nb IN RADIOACTIVE FALLOUT. Tatewaki, Tadashi (Shinshu Univ., Nagano, Japan). Shinshu Daigaku Nogakubu Kiyo; No. 29, 1-17(Dec 1970). (In Japanese).

Estimates were made of the elapsed time after a nuclear explosion by measuring the activity ratios of ^{95}Zr to ^{95}Nb in radioactive fallout. By means of a Ge(Li) γ-ray detector, photopeaks due to ^{95}Zr 724.3 keV γ-ray and ^{95}Zr 756.8 keV γ-ray were distinguished from each other, while those due to ^{95}Zr 756.8 keV γ-ray and ^{95}Nb 765.8 keV γ-ray belonging to same decay chain (mass = 95) were not completely resolved and took form of complex photopeaks. The area of each complex photopeak was resolved into 2 component-peak areas by a 2-component separation procedure. Activities of the γ-rays were measured from the resolved photopeak areas, and activity ratios of the γ-rays, Rb = (^{95}Zr 724.3 keV + ^{95}Zr 756.8 keV)/^{95}Nb 765.8 keV, Rc = ^{95}Zr 724.3 keV/^{95}Nb 765.8 keV, Rd = ^{95}Zr 756.8 keV/^{95}Nb 765.8 keV, and Re = ^{95}Zr 724.3 keV/(^{95}Zr 756.8 keV + ^{95}Nb 765.8 keV). A numerical table for the activity ratios Rb, Rc, Rd, and Re expressed as functions of elapsed time after nuclear explosion was obtained with an electronic computer. Experimental values of the elapsed time obtained from highly radioactive fallout particles due to nuclear explosion in China on December 24, 1967 were in good agreement with theoretical values obtained from calculations. The error of the elapsed time after a nuclear explosion estimated from the activity ratio Rb was smaller than that obtained from the other activity ratios Rc, Rd and Re, due to independence from the branching ratio. (Japan)

25514 ARRAY DETECTION AND LOCATION OF CORE SHADOW EVENTS. Datt, Ram; Varghese, T. G. (Bhabha Atomic Research Centre, Bombay). Bull. Seismol. Soc. Amer.; 62: No. 1, 231-45(Feb 1972).

The spectral features and slowness vector of the PKIKP and PP signals recorded clearly at the Gauribidanur Seismic Array (GBA) from four underground explosions (m_b = 5.6, 5.9, 6.2 and 6.6) at the Nevada Test Site (NTS) were studied in detail. From the spectral similarity which characterizes their phase-summed signals,

in the band from 0.5 cps to 1.5 cps, it was possible to synthesize reference signals, corresponding to these phases. By "chirping" these signals against the appropriately-phased array beams, the onset of these phases was identified for such events down to m_b = 5.3. Application of techniques of velocity and frequency filtering to the GBA records corresponding to 16 well-recorded NTS events ($\Delta \sim 127.7°$ and the San Fernando earthquake of February 9, 1971 $\Delta \sim 129.9°$) failed to reveal any precursor to the principal PKP phase which corresponds to the DF branch (PKIKP) of the Bolt (1968) curve. It is found that only the PP phase shows significant spectral differences between the earthquake and set of explosions investigated. (auth)

25515 AMPLITUDES OF TELESEISMIC P WAVES. Nuttli, Otto W. (St. Louis Univ.). Bull. Seismol. Soc. Amer.; 62: No. 1, 343-56(Feb 1972).

Amplitudes of P waves recorded by long-period seismographs for nuclear explosions in Novaya Zemlya, the Nevada Test Site, and Amchitka Island yield a new body-wave magnitude calibration function for teleseismic distances. At some distances, it differs from the Gutenberg–Richter (1956) function by as much as 0.4 magnitude units. A comparison of short- and long-period body-wave magnitudes for the 1966 Novaya Zemlya event indicates that anelastic attenuation of P waves is greater in the upper than in the lower mantle, but, for waves with periods of 1 sec or greater, the effect of anelastic attenuation on the amplitudes is less than that of geometric spreading. The amplitude data hint at the existence of a second-order velocity discontinuity in the lower mantle at a depth of about 2300 km. (auth)

25516 ARRAY STUDIES OF SEISMIC WAVES ARRIVING BETWEEN P AND PP IN THE DISTANCE RANGE 90^0 TO 115^0. Wright, C. (Dept. of Energy, Mines, and Resources, Ottawa). Bull. Seismol. Soc. Amer.; 62: No. 1, 385-400(Feb 1972).

Arrival times, slownesses and azimuths for coherent signals arriving between P and 60 sec after PP have been measured for 12 earthquakes recorded at the Yellowknife array at distances from 90 and 115°. The slowness ($dT/d\Delta$) and azimuth values for P indicate that corrections to $dT/d\Delta$ for local structure beneath the array are small and can be neglected. A statistical study of arrivals from 10 events at distances less than 103° did not demonstrate conclusively the existence of PdP waves, and revealed a pattern of slowness values for precursors to PP similar to that observed by Wright and Muirhead (1969) at a distance of 106.0°. Further, a more detailed examination of three events at distances of 93.1, 105.5 and 114.5° showed the presence of precursors with slowness values of about 10 sec/deg. These results required the development of an asymmetric reflection hypothesis in which the large amplitudes of these waves are produced by cusps in the travel-time curve near 20° and lateral variations in the uppermost regions of the Earth. (auth)

25517 BODY-WAVE MAGNITUDE AT 1 HZ AND 2 HZ AS A SHORT-PERIOD DISCRIMINANT BETWEEN EARTHQUAKES AND EXPLOSIONS. Miyamura, S.; Hori, M. (Tokyo Univ.). Bull. Seismol. Soc. Amer.; 62: No. 1, 411-12(Feb 1972).

A P-wave spectral ratio method for discriminating between earthquakes and underground nuclear explosions is proposed and illustrated with data measured in Japan following earthquakes and Soviet underground nuclear explosions. It is contended that two P-wave magnitudes m_P^1 and m_P^2 at 1 Hz and 2 Hz, respectively, can be defined and conveniently used on a routine basis as a short-period discriminant. (L.C.L.)

25518 RESIDUALS AND VELOCITIES OF P_n WAVES RECORDED BY THE SAN ANDREAS SEISMOGRAPH NETWORK. Kind, Rainer (National Center for Earthquake Research, Menlo Park, Calif.). Bull. Seismol. Soc. Amer.; 62: No. 1, 85-100(Feb 1972).

Travel-time residuals were calculated for P_n arrivals from four nuclear explosions and 10 earthquakes recorded by the U. S. Geological Survey's San Andreas seismic telemetry network. Arrivals at stations west of the fault are earlier than at stations east of the fault. Stations on basement rocks indicate a variation in crustal thickness of from 5 to 9 km across the fault at the center of the network. The average mantle velocity after correcting for the residuals is 8.0 km/s. The P_n waves traveling from the east, when corrected for crustal delay, have a velocity of from 7.7 to 7.8 km/s. Waves traveling from the north or south, after the same corrections, have a P_n velocity of from 8.0 to 8.2 km/s. This difference may be caused by an anisotropic upper mantle, but additional data from seismic sources in the Pacific will be required to confirm this result. (auth)

Civil Uses

25519 (BM-RI-7576) STRUCTURAL DEFORMATION OF GREEN RIVER OIL SHALE AS IT RELATES TO IN SITU RETORTING. Tisot, P. R.; Sohns, H. W. (Bureau of Mines, Laramie, Wyo. Laramie Energy Research Center). 1971. 27p.

Structural response and/or deformation was determined for each of four different grade Green River oil shales (27.0-, 34.5-, 45.5-, and 63.5-gal/ton) as they were heated in an inert atmosphere, under constant compressive stress, from ambient to subretorting temperatures; that is, below those required for rapid pyrolysis of the organic matter. Small cores and small columns of confined fragments comprised the test specimens, which were heated, in a specially designed microunit, at a uniform rate either to 725° or to 825°F under three different stress levels, 80, 200, and 325 psi. Structural response of some cores was observed as they were heated in a stress-free environment. The obtained stress-strain-time-temperature relationships provide information regarding the oil shale's yield temperature, yield stress, rate of compressive strain, loss of mechanical strength, and nature of structural deformation. Effects of structural deformation on induced permeability in small columns of fragments are presented. Results indicate that undergroud retorting of Green River oil shale may be seriously impaired through loss of induced permeability brought about by structural deformation of rich oil shale under the influence of heat and compressive stress. (auth)

25520 (NCG-TR-29) INITIATION OF FAILURE IN SLOPES IN OVERCONSOLIDATED CLAYS AND CLAY SHALES. Constantopoulos, Ioannis V.; Christian, John T.; Whitman, Robert V. (Massachusetts Inst. of Tech., Cambridge. Soil Mechanics Div.). Jan 1971. 147p. Dep. NTIS.

For Army Engineer Nuclear Cratering Group, Livermore, Calif.

The conditions leading to the initiation of failure in slopes of overconsolidated clay or clay shale are investigated by means of two finite element programs. The analysis is two-dimensional and assumes plane strain in a homogeneous semi-infinite mass. Further, the material is assumed to be linearly elastic and isotropic with body forces. No pore pressure effects are analyzed. It is shown that there is a considerable difference between the case in which horizontal stresses are induced by horizontal forces exerted far from the slope and the case in which horizontal stresses are "locked in" and released by excavation. The former case is simulated by the code FEAST 1 which has boundary conditions modeling a smooth bottom. The later case is simulated by the code COREXC which is given boundary conditions modeling a smooth and a rough bottom. The smooth bottom models conditions in which relative movement in the horizontal direction is allowed between soil profiles. The rough bottom assumes adhesion between soil profiles. The effects of the coefficient of earth pressure (K_0), slope angle (α), and the angle of internal friction (ϕ), are investigated for the two smooth bottom models and the one rough bottom model. The results are presented in the dimensionless ratio $c/\gamma H_0$ where c is the cohesion required to prevent the beginning of failure and γH_0 is the overburden stress at the toe before excavation. The shear stresses at the toe of the slope for the case where horizontal forces are exerted far from the slope are nearly twice those for the case in which horizontal forces are released by excavation. If horizontal forces are released by excavation, the most stable conditions prevail when the bottom of the layer is rough. In all cases high values of K_0, low values of ϕ, and high values of α lead to the least stable slopes. (auth)

25521 (NVO-100) MODEL FOR PREDICTING EFFLUENT RELEASE FROM A DEEPLY-BURIED, GAS STIMULATION NUCLEAR DETONATION. Pastore, R. M. (Nevada Operations Office (AEC), Las Vegas). Nov 1971. 31p. Dep. NTIS.

Prompt venting of a deeply-buried gas-stimulation nuclear detonation was considered not credible. Inadvertent leakage of gaseous radionuclides was assumed to occur at some time following the detonation through the most probable leak path, the annular region between the casing, and the drilled hole. Darcy gas flow calculations use a driving pressure based on realistic cavity pressure growth. A time history of growth to steady-state flow was also included. The resultant radioactive effluent is assumed to be dispersed by air currents, and the biological dose rates at specified downwind distances were calculated as a function of time. This seepage model is applicable to a wide range of path characteristics, driving pressures, meteorological conditions, and geographical zones of interest. Reduction of the model to a computer code is contemplated. (auth)

25522 (TID-25966) GEOHYDROLOGY OF PROJECT GNOME SITE, EDDY COUNTY, NEW MEXICO. Cooper, James B.; Glanzman, V. M. (Geological Survey, Washington, D. C.). 1971. 27p. GPO $1.00.

On December 10, 1961, a nuclear device was detonated 1200 ft underground in the massive salt of the Salado Formation in southeastern Eddy County, N. Mex. In support of the public safety program of the U.S. Atomic Energy Commission, the

water regimen of about 1200 sq. miles, mostly east of the Pecos River and within 15 miles of the project site, was investigated before, at the time of, and after the explosion. Preliminary investigations determined that about 70 wells were in use in the area around the Project Gnome site. The wells range in depth from a few tens of feet to nearly 800 ft and tap water in rocks of Permian, Triassic, Tertiary, and Quaternary ages. Most ground water in the area is saline; however, it is a valuable resource utilized for stock water. Seven test holes drilled at the project site penetrated similar sequences of rocks overlying the massive salt. All aquifers in the Project Gnome area lie above the massive salt of the Salado Formation. The only water at the project site is contained in the Culebra Dolomite Member of the Rustler Formation, a confined aquifer about 30 ft thick. The aquifer is about 500 ft beneath the surface and about 200 ft above the top of the salt. The potentiometric surface for the confined water is 75 ft above the top of the aquifer and slopes from 0.2 to 1.0 ft/mile westward. Fluctuations of water levels observed in wells are small. Data from a pumping test on the aquifer at the Project Gnome site indicate that 100 gpm could be pumped continuously from a well for as long as 1 y without lowering pumping levels below the top of the aquifer. Pressure changes in the aquifer due to the release of water through drill holes and removal by bailing were easily detected by a recording gage. Water levels in four observation wells at the site were being recorded at the time of the nuclear explosion. The estimated maximum rise of water level immediately following the explosion was about 4 ft at a distance of 2,000 ft from ground zero. About 3,200 ft from ground zero, the water level rose about 2.2 ft, then gradually returned to normal level within a period of about 11 h. Water in the four test holes returned to preexplosion levels 2 d after the explosion. Continued observations of water level in those holes and three additional observation wells indicated no anomalous water-level fluctuations after the nuclear explosion, suggesting that the aquifer probably was not significantly ruptured by the explosion. (auth)

Protective Structures and Equipment

25523 (ARH–2082) MAJOR PROGRAM ISSUE FOR FY 1973: IMPROVED RISK FIRE PROTECTION, 200 AREAS. Nisick, N. P. (Atlantic Richfield Hanford Co., Richland, Wash.). 26 May 1971. Contract AT(45-1)-2130. 30p. Dep. NTIS.

Improvements necessary to upgrade the 200 Area fire protection systems to the equivalent of the so-called improved risk classification in all facilities with a potential for significant radioactive contamination spread, excessive property loss, or the shut down of essential services as a result of a fire are described. The standard of fire protection for the 200 Area facilities has been steadily upgraded and improved over the past years. The continuing intent is to achieve and maintain an improved risk status in 200 Area facilities with inordinate loss potential, consistent with the intent of U. S. Atomic Energy Commission (AEC) Manual Chapter 0552, AEC Appendix 0552, and the Richland Operations Office (RL) Supplement. (auth)

25524 (JAERI-M–4565) DEVELOPMENT OF A REMOTE CONTROL POLISHER FOR THE HOT CELL. Sonobe, Kiyomi; Mimura, Hideaki; Matsushima, Hideo; Ishimoto, Kiyoshi (Japan Atomic Energy Research Inst., Tokyo). Sep 1971. 38p. (In Japanese). NTIS (U. S. Sales Only).

Metallographic caves were expanded in a hot laboratory to monitor fuels from the JAPC Tokai power reactor, JRR-2, JRR-3, and JPDR. A line of lead cells for metallography was also constructed adjacent to the expanded concrete caves. In the process of metallography, the condition of polished specimen surfaces has significant influence upon observations and microphotography; also the polished surface condition is dependent on the polisher used. The development of a highly effective polisher has been achieved, and the polisher has been used satisfactorily in the lead cell line. The procedure leading to this development is described. (auth) (Japan)

25525 ARRANGEMENT FOR INSTALLING A GLOVE AT THE ENTRANCE TO A VESSEL. Townsend, Eric (to Commissariat a l'Energie Atomique). British Patent 1,267,910. 22 Mar 1972. Priority date 30 May 1969, France.

A method for installing a glove at the entrance to a shielded vessel for radioactive material is described. An expansible sealing ring is used which has hinged elements and is characterized by members projecting radially inward from a collar at the entrance to the vessel, protecting the ring from impacts when locked in position. (J.R.D.)

25526 PLUTONIUM FUEL DEVELOPMENT LABORATORY OF POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION. Suzuki, Susumu (Power Reactor and Nuclear Fuel Development Corp., Ibaraki, Japan). Nippon Genshiryoku Gakkaishi; 14: No. 3, 124-30(Mar 1972). (In Japanese).

The Second Plutonium Fuel Development Laboratory of the Power Reactor and Nuclear Fuel Development Corporation has been completed, and production of Pu fuels for both FBR and ATR commenced in Feb. 1972. The total floor space is about 9,000 m^2 in which are housed separate production lines for FBR and ATR (pellet preparation, pin fabrication, assembling and recovery), as well as areas for quality control, fuel storage, air conditioning, and management office. The annual production capacity is 5 tons and 3 tons for ATR and FBR, respectively. Some of the production facilities were equipped to operate automatically in order to reduce the risk of human radiation exposure. Systems for criticality control and material balance are described together with an outline of the arrangement of the facilities with fully equipped alarm system. (auth)

25527 HELIUM PERMEABLE CONTAINERS. Frank, Louis; Kling, Harry P. (to Hittman Associates, Inc.). U. S. Patent 3,645,703. 29 Feb 1972 Filed 28 Jul 1966.

An alpha-emitting radioisotope source container which allows for the controlled release of helium gas without permitting any radioactive material to escape is described. The container is a metal-fiber composite of helium impermeable metallic wall with helium permeable quartz fibers reinforcing the wall and extending continuously through at least a portion of the wall and providing a fibrous helium leak path. (Official Gazette)

25528 CYLINDRICAL CELL FOR THE MANIPULATION OF RADIOACTIVE ELEMENTS. Bertoni, Bruno; Delfosse, Jean (to Commissariat a l'Energie Atomique). British Patent 1,265,940. 8 Mar 1972. Priority date 28 Jan 1970, France.

A seal-tight generally cylindrical enclosure for handling, preparation, and study of radioactive materials is described. The enclosure is provided with biological shielding and a bottom supported turntable. A window and lamps are also provided along with telemanipulators or mechanical grabs. (J.R.D.)

25529 IMPROVEMENTS IN AND RELATING TO REMOTE CONTROL SYSTEMS. (to Societe Pour l'Industries Atomique). British Patent 1,267,315. 15 Mar 1972. Priority date 13 May 1969, France.

A system is described which can be used to remotely control the rotation of a series of parallel and independent shafts. A single control member in this system transmits movement to a selected shaft while simultaneously locking the other shafts. (J.R.D.)

Safety Engineering

Refer also to abstracts 26143 and 27611.

25530 (WCAP–7861) METHODS OF DETERMINING THE PROBABILITY OF A TURBINE MISSILE HITTING A PARTICULAR PLANT REGION. Semanderes, S. N. (Westinghouse Electric Corp., Pittsburgh, Pa.). Feb 1972. 169p.

A method of estimating the probability of a turbine fragment-type missile impacting a particular region of the power plant is described. Graphs and tables relating ground angle and flight distance to initial trajectory angles and missile velocity are used. The two-dimensional problem in the ground plane can be treated exactly, whereas the more general three-dimensional case including shadowing effects requires a more approximate treatment unless recourse is made to the computer. (auth)

25531 EARTHQUAKE RESEARCH NEEDS FOR NUCLEAR POWER PLANTS. Jackson, Melvin W. J. Power Div., Amer. Soc. Civil Eng.; 97: No. PO-3, 722-7(Jul 1971).

The needs for more research applicable to construction of earthquake-resistant power plants are discussed. Examples are presented to show that conservatism in seismic design can be achieved at little increase in costs. Criteria for building survival in seismic shocks are given along with discussions of ground motion characteristics. It is noted that earthquake damage often results from failure to apply known technology relative to shock-resistant structures. (J.R.D.)

25532 FIRE EXTINGUISHING MEASURES FOR RADIOISOTOPE FACILITIES. EXTINGUISHING EFFECT OF CARBON DIOXIDE ON LIQUID FIRES IN HOODS. Morikawa, Tokio; Shimada, Hirohisa; Moriya, Tadao (Fire Research Inst. of Japan, Mitaka). Shobo Kenkyusho Hokoku; No. 30, 11-17(Dec 1969). (In Japanese).

An experiment was carried out to determine the amount of carbon dioxide required to extinguish fires in hoods of different sizes and different opening areas with changing rate of carbon

dioxide application, rate of ventilation, and means of carbon dioxide discharge. Extinction time increased with the rate of ventilation and decreased with the rate of CO_2 application in both vaporized discharge and direct discharge methods. In the former case, carbon dioxide was discharged in gaseous form; in the latter case it was discharged directly from CO_2 cylinders in the form of a mixture of gas and solid. Patterns of extinction time curves in both discharge methods were similar. Concentration of carbon dioxide was generally higher in upper region than in lower region of the hoods. Dimensionless relation between the rate of carbon dioxide application, q/Q and the amount of carbon dioxide required for extinguishing fires, qt/V was obtained from all data, where q is the rate of carbon dioxide application, Q the rate of ventilation, t the extinction time, and V volume of the hoods. Most suitable value of q/Q was 0.5 for extinguishing fires. The amount of carbon dioxide required was one fifth the volume of the hoods. Minimum carbon dioxide concentration for extinction limit was 29%, when n-hexane was used as fuel. (Japan)

Vacuum Engineering

Refer also to abstracts 25250, 25695, 26153, 26159, and 26160.

25533 (RT/EL-(71)4) VACUUM SYSTEM FOR THE STUDY OF ELECTRONIC EMISSION BY IONIC BOMBARDMENT. Catoni, F.; Cipolloni, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 7 Sep 1971. 29p. (In Italian). Dep. NTIS (U. S. Sales Only).

A vacuum system for studies on electron emission from semiconductors by ions has been built. The problems of ultrahigh vacuum obtainment are discussed. Evidence has been found for the presence of an organic contamination. Preliminary studies for a better understanding of this effect, which can be of great technological importance, are described. (auth)

25534 PROCEEDINGS OF THE FIFTH INTERNATIONAL VACUUM CONGRESS, BOSTON, OCTOBER 11–15, 1971. J. Vac. Sci. Technol.; 9: No. 1, 1-559(Jan-Feb 1972). (CONF-711045).

A total of 117 papers and 58 abstracts are presented in sections dealing with thin films in MIS technology: basic properties; vacuum techniques and deposition systems; thin films in MIS technology: application and analysis; accelerators and large vacuum systems; electrical properties of insulating films; pressure measurement; vacuum metallurgy; analytic techniques in thin films; epitaxial semiconductor films; gas flow and physical adsorption; diffusion and electromigration in thin films; electron impact on solids; MIS and superconducting film technologies; sputtering and special deposition techniques; ion impact, adsorption, and desorption; photoelectric, photoconductive, and optical properties of thin films; mechanical, turbomolecular, and diffusion pumps; memory effects in thin films; space science; mass spectrometry; structure and properties of thin films; and getter pumping and cryosorption. Separate abstracts were prepared for 33 of the papers. (D.L.C.)

For abstracts of individual papers see: 25189, 25250, 25535–25543, 25695–25697, 26034–26036, 26086, 26087, 26133, 26134, 26159, 26160, 26163, 26830–26832, 27319–27322, 27348, and 27575.

25535 TITANIUM EVAPORATION PUMP: ITS APPLICATION TO NUCLEAR FUSION EXPERIMENTS AND SPACE SIMULATION. Prevot, F.; Sledziewski, Z. (EURATOM–CEA, Fontenay-aux-Roses, France. CEN, Fontenay-aux-Roses, France). J. Vac. Sci. Technol.; 9: No. 1, 49-54(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

The pumping action of titanium is considerably enhanced if the active layer is made on a cold surface. High pumping speed of 10 liters/sec·cm^2 for usual gases, capacity at saturation of about 10^{16} molecules/cm^2, limit pressure down to 10^{-10} torr, and good cleanliness make it very attractive for a number of applications. Titanium monoxide TiO has very similar properties at low temperature, and in addition, can pump argon. Titanium pumping is particularly suited to big-size installations with very specific problems like the nuclear fusion research apparatus and the space simulation chambers. Examples of these two cases are described. (auth)

25536 MOBILE MULTISTAGE 3000-cfm PUMPING SYSTEM. Wilson, N. G. (EG and G Inc., San Ramon, Calif.). J. Vac. Sci. Technol.; 9: No. 1, 60-4(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

A trailer-mounted two-stage booster mechanical pumping system has been constructed for use in evacuation of large vacuum vessels in remote locations. The pumping system is composed of three nominal 1500-cm air-cooled Roots blowers and four nominal 150-cfm mechanical pumps. It includes a high conductance cryogenic baffle, a self-contained helium leak detection station with a high-speed oil diffusion pump, a liquid cryogenic system for supply of cryogenic fluids to the two cryogenic traps, and dry gas for use in backfilling of vessels as required. A programmed start-up and run-down control is provided for simplified, safe operation of the pumping system. A simplified method of presenting pumping system performance and a design analysis procedure for matching of mechanical pumps to the boosters are described. (auth)

25537 REVIEW OF PRESSURE MEASUREMENT TECHNIQUES FOR ULTRAHIGH VACUA. Lafferty, J. M. (General Electric Co., Schenectady, N. Y.). J. Vac. Sci. Technol.; 9: No. 1, 101-7(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

This review includes a brief listing of the physical principles used in pressure measuring devices and a detailed discussion of selected topics associated with ionization gages. Ionization gages are currently the only devices available for measuring pressures in the extreme ultrahigh vacuum region. This is not because of their high sensitivity, but rather because of development of techniques for measuring small currents conveniently. Twenty-five years ago, it was not possible to measure the lowest pressures attainable. Today the situation is reversed; the lowest total pressures currently produced not only can be measured, but the composition of the residual gases can be analyzed as well. Notwithstanding their great popularity, ionization gages suffer from many sources of error. Despite these difficulties, some of which are discussed, the total pressure ionization gage can, when properly designed and operated, give pressure readings that are accurate to better than an order of magnitude and perhaps even a few percent under ideal conditions when carefully calibrated and the gas composition is known. The low pressure limit of present ionization gages not using electron multipliers is determined by the low space charge densities at which they must be operated to avoid instabilities associated with high random energy electrons. Lower temperature electron emitters will be required in measuring pressures below 10^{-13} torr to avoid outgassing problems. (auth)

25538 HIGH-VACUUM GAS FRICTION MANOMETER. Fremerey, J. K. (Univ., Bonn). J. Vac. Sci. Technol.; 9: No. 1, 108-11(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

A new version of the well-known "spinning-rotor pressure gage," which was described in 1962 by Beams and co-workers, is presented. The magnetic suspension is now achieved under a permanent magnet by means of a servo current which is applied to the rf sensing coil. The system involves negligible power dissipation. Instead of optical devices, inductive pickup coils are used in the horizontal damping system as well as for the determination of the rotor frequency. The whole system thus avoids undesired heat and radiation transfer to the rotor and vacuum chamber. The gas pressure sensitivity is of the order 10^{-9} torr. (auth)

25539 USE OF A FIELD-ELECTRON EMITTER AS A PRESSURE INDICATOR IN ULTRAHIGH VACUUM. Emons, A. J.; Hagemans, K. L. (Delft Univ. of Tech., Netherlands). J. Vac. Sci. Technol.; 9: No. 1, 112-16(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

An investigation was made to determine whether the rate of adsorption on a field-electron emitter can be used for pressure indication in ultrahigh-vacuum systems. Research has proved that for hydrogen which is the dominant component of the residual gas in such systems, there is a linear relationship between the measured rate of adsorption and the pressure reading on a Bayard–Alpert gage. The highest pressure that can be determined by this method is limited by the maximum measuring speed; the lowest by the necessity to have a certain number of particles adsorbing on the small emitter surface within a reasonable course of time so that adsorption can be measured with a certain accuracy. This method can be used in the pressure range from 10^{-9} to 10^{-13} torr. (auth)

25540 ION COLLECTION IN BAYARD–ALPERT GAGES. Comsa, George (Inst. of Atomic Physics, Bucharest). J. Vac. Sci. Technol.; 9: No. 1, 117-21(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

The theoretical dependence of the ion collection in Bayard–Alpert gages (BAG) with open-end grid on ion initial energy, ion "birth place," geometrical and electrical parameters, is briefly presented. The resulting consequences concerning the behavior and the main features of BAG as well as the expected values of the collection factor are compared with available experimental data. The results of this comparison and the peculiarities of the ion collection in BAG with closed-end grid are analyzed. Finally, the practical consequences concerning two distinct application areas of the BAG are discussed: (a) the total pressure measurements and (b) the utilization of the very high sensitivity of the ion collection with respect to the initial ion velocities for thermal and subthermal ion velocity spectrometry (e.g., for the measurement of momentum transfer at charge exchange and at ionization with slow electrons). (auth)

25541 BEHAVIOR OF THE BAYARD–ALPERT GAGE WITH CAGE MODULATOR OPERATING WITHOUT ELECTRON CURRENT. Szwemin, P. J. (Warsaw Technical Univ.). J. Vac. Sci. Technol.; 9: No. 1, 122-5(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

Besides the classical method of ion current modulation there are other modes applied to the BAG with modulator. In the new method (proposed by Groszkowski), the cage modulator is operated without electron current, while reasonable high modulation factor is obtained. The behavior of this gage is presented in a wide range of pressures for both noble and active gases. The comparison of the classical method with the new one is also given. The new method allows elimination of adsorption and desorption processes from the modulator as a main disadvantage of the classical method. (auth)

25542 COMPARISON OF THE PRESSURE INDICATION OF A BAYARD–ALPERT AND AN EXTRACTOR GAGE. Beeck, U.; Reich, G. (Leybold–Heraeus GmbH, Cologne). J. Vac. Sci. Technol.; 9: No. 1, 126-8(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

Previous measurements by Redhead have shown that a main advantage of the extractor gage (EG) in comparison with the Bayard–Alpert gage (BAG) is the very much reduced influence of electronic desorption on the pressure indication. Detailed comparative measurements were made and have shown that when pumping a uhv system for the first time, or switching off for a period and reenergizing, the pressure indicated by the EG is 3 to 5 times lower than that indicated by the BAG and after degassing the gages the pressure readings are almost the same, but higher because of increased gas desorption. The influence of the electronic desorption effect has been quantitatively investigated. The measurements confirmed that the reading of the EG is lower and more correct than the BAG reading under similar conditions. (auth)

25543 SOME RECENT DEVELOPMENTS IN LOW-PRESSURE MEASUREMENTS USING EXTERNAL COLLECTOR IONIZATION GAUGES. Steckelmacher, W.; Fletcher, B. (Edwards High Vacuum International, Crawley, Eng.). J. Vac. Sci. Technol.; 9: No. 1, 128-32(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

In an attempt to reduce the residual current in thermionic ionization gages (due to x rays as well as electron-induced desorption), suggestions have been made over the last 10 years to mount the collector external to the grid space. The behavior of such gages has been extensively studied both from the point of view of ion production, the ion collection mechanism, as well as the effect of residual currents. The performance of an external-collector gage of simple construction, high intrinsic sensitivity, and with residual current limits several orders lower than the conventional Bayard–Alpert gages was evaluated in relation to other recent proposals. This gage was provided with a modulator electrode to permit verification of residual current limits, an external screen eliminated wall effects both in tubular and immersed (nude) gage constructions, while the use of an electron reflector grid situated behing the filament ensured more efficient gas-phase ion production and ion collection with consequent high sensitivity. The latter combined with the external collector construction ensured a low ratio of residual current to gage sensitivity. (auth)

25544 INFLUENCE OF THE GRID AND ION COLLECTOR DIAMETERS ON THE SENSITIVITY FACTOR AND THE MEASURING RANGE OF THE BAYARD–ALPERT GAGE. Szwemin, P. (Technical Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 19: No. 11-12, 839-46(1971).

The influence of the diameters of the grid and of the ion collector on the sensitivity factor, x-ray residual current, and lower pressure limit of the Bayard–Alpert gage (BAG) has been verified experimentally. It has been found that the sensitivity factor value drops considerably when the ion collector diameter is reduced from 0.2 to 0.06 mm. This in turn makes negligible the lowering of the x-ray limit by reducing the ion collector diameter below 0.1 mm. Practically, the optimum diameter seems to lie between 0.1 to 0.2 mm. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

25545 (CEA-R-4207) UTILIZATION OF VEGETATION AS DETECTOR OF FLUORIDE POLLUTION AROUND A PLANT EJECTING GASEOUS FLUORIDE EFFLUENTS. Teulon, Francoise (Commissariat a l'Energie Atomique, Pierrelatte (France)). Aug 1971. 31p. (In French). Dep. NTIS (U. S. Sales Only).

Fluorine pollution (chronic or occasional) around a plant ejecting gaseous fluoride effluents can be detected from vegetation samples by chemical analysis. Systematic monitoring allows the effects and gravity of the pollution to be estimated. The analytical method used consists of a double distillation (in phosphoric acid and perchloric acid) followed by a spectrocolorimetric analysis (alizarine-complexon-lanthane). This method of control allows both the efficiency of the trapping installations and also the appearance of effluents at unexpected places to be checked. In the event of an accident it is possible to determine the advisability of prohibiting the consumption of locally grown produce by humans or fodder by cattle. Research conducted in order to determine the relation between visible damage to certain vegetables (tomatoes, haricot beans, and sorghum) and their fluorine contents demonstrated that such a relation appears most markedly at the level of the leaves; chemical analysis may thus be used to confirm or reject information obtained on the basis of visual evidence. (auth)

Minerals and Ores

Refer also to abstracts 25651, 25657, 26001, and 26002.

25546 THORIUM AND URANIUM IN MARINE BARITE. Church, Thomas M.; Bernat, Michel (Univ. of California, San Diego, La Jolla). Earth Planet. Sci. Lett.; 14: No. 1, 139-44(Feb 1972).

Analyses of thorium and uranium from deep-sea barites and their sediments show that: marine barites concentrate thorium relative to their bulk sediments and appear to be growing near the sediment surface. However, some barites are found associated with ferromanganese deposits, and these barites, like continental varieties, are depleted in thorium and may reflect formation or alteration from effects of volcanic processes; while marine barites show $^{230}Th/^{232}Th$ depositional rates analogous to their sediments, they have distinctly lower isotope ratios which may reflect their formation from deep-sea or pore water; and marine barites, like phillipsites and sea water, contain excess amounts of ^{228}Th and are probably undergoing a continuous exchange chemistry within the thorium series as the result of ^{228}Ra mobilization in the sedimentary column. (auth)

25547 URANIUM AND THORIUM ISOTOPE GEOCHEMISTRY IN FERROMANGANESE CONCRETIONS FROM THE SOUTHERN OCEAN. Schornick, James Curtis Jr. Tallahassee; Florida State Univ. (1971). 156p. University Microfilms Order No. 72-9215.

Thesis.

The first systematic investigation of uranium and thorium isotopes in ferromanganese concretions from the Southern Ocean is reported. Both the uranium and thorium in these deposits are almost totally authigenic and are extracted from sea water by colloidal iron scavenging. The Th/U ratio generally has a fairly narrow range within individual geographic areas; however, in concretions from different regions the ratio is distinctive. Samples within a given area show similar concentrations of iron, manganese, uranium, and thorium. The excess ^{230}Th and $^{230}Th/^{232}Th$ decay curves have exactly the same shape for any given sample. Accumulation rates derived from these curves show that north of 50° South the accumulation rates are uniform and slow, while south of this line the rates are much faster and variable. The accumulation rates range from 5 mm/10^6 y to almost 70 mm/10^6 y, a factor of seven greater than reported for nodules from other parts of the Pacific. The disequilibrium data suggest that the $^{230}Th/^{232}Th$ ratio method is valid for absolute dating of Fe/Mn concretions. In cases where the rate of accumulation is constant, the constant activity and constant flux models are also valid. Where the rate of accumulation of a given concretion has been variable with time, use of the elemental concentrations of iron, manganese, uranium, and thorium can be helpful in deciding whether constant activity or constant flux might be valid under these conditions. Assumptions that may be valid in dating Fe/Mn concretions are probably not valid for dating the deep sea sediments associated with the concretions. The accretion rates of Southern Ocean Fe/Mn concretions vary by a factor of up to seven, but the elemental ratios of iron, manganese, uranium, and thorium vary by only a factor of two or less. Thus, where little or no correlation exists between two variables on a concentration basis, a strong positive correlation emerges based on accumulation rate data. Although Fe/Mn concretions appear to have high concentrations of uranium and thorium compared to deep sea sediments, the rate of accumulation of the elements per unit area in the Fe/Mn concretions is much less than in the sediments. (Diss. Abstr. Int., B)

25548 EVOLUTION OF THE PROSPECTION AND INVESTIGATION OF URANIUM DEPOSITS. Tamayo, Juan Martin-Delgado (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 15: No. 73, 361-9(Sep-Oct 1971). (In Spanish).

A brief review is given of the evolution of the uranium industry and prospection in the world. The reasons for the present emphasis on sedimentary earths are summarized. The problems in the prospection for sedimentary uranium deposits in Spain are outlined after a review of the energy needs of the country. (J.S.R.)

25549 PROSPECTION PROBLEMS AND PLANS IN THE JUNTA DE ENERGIA NUCLEAR. Rodriguez, Ricardo Arteaga (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 15: No. 73, 371-4(Sep-Oct 1971). (In Spanish).

The task of the Division of Geological Investigation is to locate and evaluate economic ores at present prices and to estimate the uranium potential of the country, cataloging zones with various grades of possibility. The initial surveys are made by plane and then prospection is made by foot on the most promising areas. (J.S.R.)

25550 SECONDARY MINERALS OF URANIUM AND THEIR GEOLOGICAL FORMATION SURROUNDINGS. Santoma, Luis (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 15: No. 73, 375-80(Sep-Oct 1971). (In Spanish).

The term secondary minerals of uranium is equivalent to hexavalent uranium minerals. The properties of the uranyl ion are outlined. The structural characteristics of uranyl minerals and their classification are given. The properties of the uranyl ion in aqueous phases are summarized. The formation of solid mineral phases of hexavalent uranium is discussed. (J.S.R.)

25551 CONSIDERATIONS ON THE METALLOGENESIS OF THE NATURAL URANIUM: ORGANIC ASSOCIATION. Calvo, M. Martin (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 15: No. 73, 381-7(Sep-Oct 1971). (In Spanish).

The evolution of organic material through humification, turbification, lignification, bituminous formation, and graphitization is outlined. The reasons why organic material in the first stages of carbonization has a great tendency to fix uranium and combine with it are discussed. (J.S.R.)

25552 SOME IDEAS ON ISOTOPIC FRACTIONIZATION OF SULFUR IN URANIUM MINERALIZATIONS. Saenz, M. Lucini (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 15: No. 73, 388-93(Sep-Oct 1971). (In Spanish).

The factors and processes leading to the enrichment of ^{32}S in uranium deposits are described and discussed. The isotopic geology in Gas Hills, Wyoming, is outlined. Variations of ^{34}S in the front of the uranium roll are discussed. (J.S.R.)

25553 AERIAL PROSPECTION: IMPROVEMENTS INTRODUCED IN THE LAST CAMPAIGNS. Mahou, E. Suarez; Hernandez, J. Cerrajero; Vicente, A. Crego (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 15: No. 73, 408-14 (Sep-Oct 1971). (In Spanish).

The most recent aerial prospection campaign is described to illustrate the improvements made in this technique. The advantages and disadvantages of the plane, radioaltimeter, scintillometers, and recorders are given. The in-flight operations are described. The processing and presentation of the data are considered. (J.S.R.)

25554 ORES IN SEDIMENTARY FORMATIONS OF FRANCE AND AFRICA. CRITERIA AND CONCLUSIONS WITH RESPECT TO GENESIS AND ORIENTATIVE NORMS DERIVED FROM THEM FOR THE PROSPECTION OF THE PENINSULA. Ramirez, E. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 15: No. 73, 421-30(Sep-Oct 1971). (In Spanish).

A synthesis of the principal sedimentary uranium deposits of France and Africa is presented. From this synthesis conclusions are drawn which can be valid for uranium prospection in Spain. (J.S.R.)

25555 PRESENT STATE OF THE GEOLOGICAL INVESTIGATION IN THE ZONE OF SORIA. Castanon, A. (Junta de Energia

Nuclear, Madrid). Energ. Nucl. (Madrid): 15: No. 73, 431-4 (Sep-Oct 1971). (In Spanish).

As a result of a series of systematic radioactive prospections in the Iberian Cordillera, important radioactive discoveries were located. The geology of the Sorian zone is described. The preliminary geological surveys indicate anomalies which can reflect a possible uranium deposit to the south of these anomalies. (J.S.R.)

Radioactive Effluents

Refer also to abstracts 26027, 27413, 27419, 27480–27482, 27493, 27507, 27514, 27515, 27520, and 27522.

25556 (DOCKET-50268-26) MIDWEST FUEL RECOVERY PLANT. Draft Detailed Statement on Environmental Considerations Related to Proposed Operation. (Division of Radiological and Environmental Protection (AEC), Washington, D. C.). Mar 1972. 86p. Dep. NTIS.

Environmental considerations related to the proposed issuance of an operating license for the Midwest Fuel Recovery Plant are discussed. The site, plant, environmental impact of site preparation and plant construction, environmental impact of plant operation, probable adverse effects, short-term uses and long-term productivity, commitments of resources, alternatives to proposed action and cost–benefit analysis of their environmental effects are considered. (M.C.G.)

25557 PERMISSIBLE ACTIVITY DISCHARGE INTO RECEIVING WATERS THROUGH RADIOACTIVE WASTE WATER FROM NUCLEAR POWER PLANTS. Brunner, P. G. Wasser Boden; No. 4, 124-6(1971). (In German).

Details are given of the future consumption of electric energy and of the future installed electric power from nuclear power plants. Based thereon, the permissible radioactivity discharge per 100 MWe into waters is determined to be 1.5 Ci/a, except T, for a total power of nuclear power plants of 100,000 MWe. Considering the capacity of decontamination plants the permissible activity discharge per 100 MWe can be provisionally established to be 1 Ci/a. (INIS)

Radioactivity Transport and Monitoring

Refer also to abstracts 25501 and 25508.

25558 (DOCKET-50201-112) WEST VALLEY REPROCESSING PLANT. Environmental Report No. 11, 2nd Half, 1971. (Nuclear Fuel Services, Inc., West Valley, N. Y.). 29 Feb 1972. 30p. Dep. NTIS.

Over 2000 separate analyses of air, water, milk, fish, deer, and silt were performed in the 6 months period. Discharges of ^{90}Sr from the lagoon system decreased by a factor of 3 compared with the first half of 1971 and by a factor of 9 compared to 1970. ^{137}Cs discharges decreased by a factor of 5 compared with the first half of 1971. ^{131}I, tritium, and ^{85}Kr were monitored in stack effluent. Data are presented in tables. (M.C.G.)

25559 (EGG-1183-1522) ENVIRONMENTAL RADIATION SURVEYS AND SNOW MASS PREDICTIONS FROM AIRCRAFT. Technical Report No. L-1034. Deal, L. J.; Doyle, J. F.; Burson, Z. G.; Fritzsche, A. E. (EG and G, Inc., Las Vegas, Nev.). 25 Jun 1971. 23p. (CONF-710540-1). Dep. NTIS.

From seventh international symposium on remote sensing of environment; Ann Arbor, Mich. (17 May 1971).

An aerial radiation detection and tracking system is described and its use in recording radiation levels from isotopes in air, on the ground, or in the soil is discussed. Information is included on instrumentation and radioisotope detectability. Experiments and field tests are described to illustrate the capabilities of the system. (J.R.D.)

25560 (JPRS-55430) TRANSLATIONS ON EASTERN EUROPE. Scientific Affairs No. 230. Translation of articles on Eastern Europe. 26p. NTIS.

Four papers are included in the translation. One paper is in the scope of NSA and is concerned with calculation of the relative concentration and mass of fallout particles in nuclear explosion clouds. (J.R.D.)

25561 (LA-4871) ENVIRONMENTAL MONITORING IN THE VICINITY OF THE LOS ALAMOS SCIENTIFIC LABORATORY, JANUARY THROUGH JUNE 1971. Herceg, Joseph E. (comp.) (Los Alamos Scientific Lab., N. Mex.). Jan 1972. Contract W-7405-eng-36. 44p. Dep. NTIS.

A description is given of the environmental monitoring program in effect at the University of California Los Alamos Scientific Laboratory during the first half of calendar year 1971. Results of programs designed to monitor radiation levels in the Laboratory environs, including the atmosphere, local surface and ground waters, sediments and soils are presented. These measurements are used to make estimates of the dose commitments due to plutonium and tritium concentrations in air. The boundaries of the Laboratory site, the programs associated with various Laboratory technical areas, geologic, climatologic, and economic characteristics of the Los Alamos area, and laboratory procedures used for the analysis of samples are described. (auth)

25562 (PEL-214) CHANGE IN CONCENTRATION OF TRITIUM IN WATER DURING EVAPORATION AND THE POSSIBILITY OF USING IT TO DETERMINE EVAPORATION FROM WATER, SOIL, AND PLANT SURFACES. van der Westhuizen, M.; Smith, Mavis J. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Sep 1971. 15p. Dep. NTIS (U. S. Sales Only).

The change in tritium concentration of open water surfaces during evaporation is discussed and experiments to test the evaporation formula of Craig and Gordon are described. The first few experiments were done to determine the unknown constant and the subsequent experiments were then used to test the formula as such. The agreement between measured and calculated values was good, as indicated by the correlation coefficients which were better than 0.95. The change in tritium concentration in the different soil layers during evaporation from the soil surface is discussed and the theory of Zimmerman et al is given. Two experiments were done and in both cases the calculated values were lower than the measured values. The possible changes in the tritium concentration in plants are discussed. Four experiments were done in which the tritium concentration in the water, soil, roots and leaves were determined. The concentration in the leaves was lower than that in the added water, and it seems that the ratio of the concentration in the leaves to that in the water is linearly related to the measured evaporation rate. The application of this method for determining evaporation from large water, soil and plant surfaces is somewhat impracticable at the present stage. With more research, it should be possible to determine the evaporation from a tree or a group of trees using this method. A thorough study of this method will throw light on the mechanism of evaporation from water, soil and plant surfaces. (auth)

25563 (RLO-2225-T-25-3) SEDIMENT TRANSPORT ON THE CONTINENTAL SHELF OFF OF WASHINGTON AND OREGON IN LIGHT OF RECENT CURRENT MEASUREMENTS. Smith, J. Dungan; Hopkins, T. S. (Washington Univ., Seattle. Dept. of Oceanography. Atomic Energy Commission, Athens (Greece)). 1971. Contract AT(45-1)-2225. 63p. Dep. NTIS.

Prolonged series of direct current measurements on the central and outer parts of continental shelves are rare; yet an understanding of the detailed flow regime in this area is of considerable geological importance. Due to the lack of this data in the oceanographic literature, especially in regard to the temporally variable near-bottom velocity field, a direct current measurement program began at the University of Washington during summer 1967. Initial emphasis was placed upon obtaining a time series of at least a two-year duration at a single location. Data were obtained with current meters located 3 m above the seabed in 50 and 80 m water. Results indicate that significant sediment transport occurs only during storms and the near bottom currents were found to have a fairly large offshore component. Calculations based on the current measurements and on analyses of sediment samples taken from the experimental site show that bed load transport of sediment is important only insofar as it affects the boundary geometry, whereas, suspended load transport of sediment is extremely important. Although no completely satisfactory suspended sediment transport theory is available, estimates indicate that a typical winter storm with current speeds up to 60 cm/s transports on the order of 5 $m^3/h/m$ of shelf length; a storm with speeds of up to 70 cm/s transports about 15 $m^3/h/m$ of sediment off of the continental shelf and into deeper water. Such calculations suggest that a severe storm occurring every few years might have more geological significance than a number of less severe storms. Some funneling of the transported material into local submarine canyons is likely but insufficient data are available to document this hypothesis. (auth)

25564 (SWRHL-81-r) OFF-SITE SURVEILLANCE ACTIVITIES OF THE SOUTHWESTERN RADIOLOGICAL HEALTH LABORATORY FROM JANUARY THROUGH JUNE 1968. (Western Environmental Research Lab., Las Vegas, Nev.). Jan 1972. 107p. Dep. NTIS.

During the period January through June 1968, eighteen announced nuclear tests were conducted in Nevada by the U. S. Atomic Energy Commission. Of these eighteen tests, three released radioactivity to the off-site environment. In addition, two operations of the Phoebus 2A nuclear rocket engine at the Nuclear Rocket Development Station released radioactivity that was detected off-site. The Southwestern Radiological Health Laboratory performed off-site radiological surveillance for the above events under a Memorandum of Understanding with the Atomic Energy Commission. The highest gamma exposure rate measured at a populated location during this period was 65 mR/h at Clark Station, 16 miles west of Warm Springs, Nevada. This measurement was taken from an RM-11 permanent exposure rate recorder during cloud passage following Project Cabriolet on January 26. A mobile ground monitor who was present during cloud passage observed only 43 mR/h using an E-500B portable survey instrument. The integrated exposure measured by a thermoluminescent dosimeter station at this location was 8 mR including cloud passage plus seven days of residual exposure. A personnel thermoluminescent dosimeter at Stone Cabin Ranch (four miles north) also measured 8 mR over this period. The maximum integrated concentration of gross beta in air detected at a populated location was 560 μCi · sec/m^3 at Stone Cabin Ranch, about 15 miles west of Warm Springs, Nevada. The maximum integrated ^{131}I concentration in air was 4.9 μCi · sec/m^3 also at Stone Cabin Ranch. These concentrations resulted from the Cabriolet experiment. The highest concentration of ^{131}I detected in milk was 630 pCi/l at Mountain View Ranch near Deeth, Nevada, from a sample collected on February 8, following Cabriolet. The maximum estimated dose to a hypothetical two-gram thyroid, used as a critical receptor, was 110 mrad after Cabriolet. No water samples, collected from sources used for human consumption, were found to contain fresh fission products. Analysis of all sampling and surveillance data collected during this six-month period indicates the safety criteria established by the Atomic Energy Commission for the off-site population were not exceeded. (auth)

25565 (SWRHL-107-r) FINAL REPORT OF OFF-SITE SURVEILLANCE FOR THE BANEBERRY EVENT, DECEMBER 18, 1970. (Western Environmental Research Lab., Las Vegas, Nev.). Feb 1972. 171p. Dep. NTIS.

The Baneberry Event was an underground nuclear weapon test conducted at the Nevada Test Site on December 18, 1970. Shortly after the detonation, fission products escaped into the atmosphere, resulting in a release of radioactivity to the off-site area. A radiological monitoring program was used to detect radioactivity in environmental media in a widespread area of the western United States. From an evaluation of the measurements of external gamma radiation levels and of radioactivity concentrations in air, milk, precipitation, water, and other media, the radiation exposures to off-site residents were found to be within the radiation protection standards of the AEC Manual, Chapter 0524. All off-site gamma exposure measurements at inhibited locations were less than one mR/h. The highest measured exposure rate obtained off-site was 1.2 mR/h one mile east of Queen City Summit, an uninhabited location on Highway 25. Based on a $t^{-1.2}$ extrapolation of ratemeter data, an estimate of 36 mR as the highest estimated infinity exposure from external gamma radiation at a populated location (Clark Station) was reported in the May 10, 1971 "Interim Report of Off-Site Surveillance for the Baneberry Event." This was noted as the most conservative estimate, and that 20 mR was a more valid preliminary value. An algorithm was later developed, based on a generalized decay scheme of ground-deposited Baneberry activity. This algorithm provided extrapolation factors which indicated 13 mR is a more appropriate estimate for Clark Station, Nevada. Using the algorithm for Baneberry activity, the highest estimated infinity exposure at an inhabited location was 16 mR at Blue Jay Highway Maintenance Station, Nevada, 66 miles northeast of Tonopah, Nevada, on Highway 6. The highest ^{131}I concentration detected in milk was 810 pCi/l at the McCurdy Ranch near Springdale, Nevada. This resulted in an estimated thyroid dose of 130 mRem to a two-year-old child who was consuming the milk. The highest estimated thyroid doses were to eight sheepherders in central Nevada who were using melted snow contaminated by the Baneberry release for drinking and cooking. Based on environmental sampling results, information from some of the sheepherders, and records of snowfall, an estimate of their thyroid dose was 0.5 Rem plus or minus a factor of 3 (i.e., 0.17 to 1.5 Rem). Higher than normal levels of radiostrontium and plutonium were detected in selected snow samples, and radiostrontium was detected on selected air filters containing radioiodine. Tritium attributed to Baneberry was also detected in selected snow samples. The highest concentrations of these radionuclides were below the Concentration Guides of the AEC Manual, Chapter 0524. (auth)

25566 RADIOACTIVITY MEASUREMENTS IN SEDIMENTARY EARTH. Serrano, Domingo Diez (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 15: No. 73, 415-20(Sep-Oct 1971). (In Spanish).

The source of the natural radioactivity of sedimentary rocks is described. The factors which affect the measurement of the radioactivity of these sedimentary rocks are described. These include the effect of the solid angle or mass effect, absorption of γ, Compton scattering, fluctuations, and effect of disequilibrium. The units used in radioactivity measurements in geology are defined. (J.S.R.)

25567 ENVIRONMENTAL RADIOACTIVITY IN MICHIGAN, 1970. Wieder, Samuel (Environmental Protection Agency, Washington, D. C.); Logsdon, Joe E.; Froom, Charles P. Radiat. Data Rep.; 13: No. 1, 3-18(Jan 1972).

Information is presented on the radioactivity from all major sources measured in the Michigan environment during 1970. The State's environmental surveillance programs and the data resulting from these programs are described. Surveillance data provided by Federal, State, operator, and contractor sources are summarized. On the basis of this information, an estimate is presented of annual radiation doses to the population of Michigan. A summary of some operating characteristics of Big Rock Point, Enrico Fermi-1 and Palisades plants is presented. (auth)

25568 SUMMARY OF ENVIRONMENTAL RADIATION SURVEILLANCE ACTIVITIES IN ARKANSAS. Sheets, Burvie H.; Oates, William H. Jr.; Snellings, David D. Jr.; Wilson, E. Frank (Arkansas State Dept. of Health, Little Rock). Radiat. Data Rep.; 13: No. 1, 19-26(Jan 1972).

Information is presented on the environmental radiation surveillance program of the Division of Radiological Health, Arkansas State Department of Health. The program has been broken into two general categories: statewide system and source-oriented surveillance activities. There are two nuclear facility sites in Arkansas and extensive surveillance activities are presently being conducted near each site. Some of the data that were collected during 1966 through 1970 are presented. (auth)

25569 RADIOACTIVE DISCHARGES AND ENVIRONMENTAL SURVEILLANCE ASSOCIATED WITH NUCLEAR POWER PLANTS. Radiat. Data Rep.; 13: No. 1, 1-2(Jan 1972).

The environmental contamination attributable to the release of radioactive wastes from nuclear power plants and the population dose effects of such releases are evaluated, and the surveillance programs necessary for monitoring and controlling these discharges of radioactivity are briefly described. (L.C.L.)

Atmosphere

25570 (NIRS-RSD-33) RADIOACTIVITY SURVEY DATA IN JAPAN. Number 33. (National Inst. of Radiological Sciences, Chiba (Japan)). Nov 1971. 20p. Dep. NTIS (U. S. Sales Only).

Results are reported from a field survey conducted during 1970 on the γ exposure rates due to natural background radiation in the Hokuriku district of Japan. Data are presented on the content of ^{137}Cs and ^{90}Sr in rice and the content of ^{90}Sr in wheat during 1969 and 1970. Samples were collected from various locations throughout Japan. The 12th nuclear test of the Peoples Republic of China was carried out on Nov. 18, 1971. Data on the gross β radioactivity in rain, dry fallout, and in the upper atmosphere of Japan during Nov. 19 through Nov. 30 are presented. (C.H.)

25571 (NRL-F-46) ENVIRONMENTAL RADIOACTIVITY IN NEW ZEALAND. Quarterly Report, July-September 1971 and Pacific Area Monitoring 31 August-31 October 1971. (National Radiation Lab., Christchurch (New Zealand)). 23p. Dep. NTIS (U. S. Sales Only).

The results of routine monitoring during July to October 1971 of radioactive fallout at 6 New Zealand and 9 South Pacific Island sampling stations are reported. Tabulated data are presented on: total beta activity in surface atmosphere and rainwater; ^{131}I and ^{90}Sr content of milk; ^{131}I content of cattle thyroids; deposition of ^{137}Cs, ^{89}Sr, and ^{90}Sr in rain. (L.C.L.)

25572 (UCRL-73182) SOCIOECONOMIC IMPACT OF LOW-LEVEL TRITIUM RELEASES TO THE ENVIRONMENT. Cohen, Jerry J.; Higgins, Gary H. (California Univ., Livermore. Lawrence Livermore Lab.). Aug 1971. 22p. (CONF-710809-14). Dep. NTIS.

From Tritium symposium; Las Vegas, Nev. (30 Aug 1971).

In accordance with FRC guidance, tritium releases must be kept below quantities where MPC levels are exceeded, and should be kept as low as practicable. Determination of practicability requires an analysis of the benefit vs risk considerations involved. Such an analysis was performed for certain general cases. It is based on a Mer value of $250 (a "mer" is the amount of benefit

required to justify a radiation exposure of one Man-Rem) and considers the nature of tritium distribution in the biosphere as well as certain demographic factors. It also assumes that constraints imposed by exposure guides are observed. The analysis indicates that sums greater than ~ $0.10/curie spent for the control of low-level tritium releases can be considered more than would be justified by the environmental risk. The assumptions and calculations are reviewed in detail. The possible social and moral implications of such an analysis are also discussed. (auth)

25573 MINERALOGICAL COMPOSITION AND ^{137}Cs RETENTION PROPERTIES OF CONTINENTAL AEROSOLIC DUSTS. Syers, J. K. (Univ. of Wisconsin, Madison); Mokma, D. L.; Jackson, M. L.; Dolcater, D. L.; Rex, R. W. Soil Sci.; 113: No. 2, 116-23(Feb 1972).

Aerosolic dusts collected from the atmosphere, mud-rains, snow, and ice varied widely in mineralogical composition. Micaceous minerals, quartz, chlorite, and feldspars were the dominant minerals; kaolinite, vermiculite, montmorillonite, amphibole, and talc were present in some of the samples. The free iron oxide content varied between 0.9 and 3.2%. In a dust of Australian origin, collected from the Franz Josef glacier in New Zealand, the free iron oxides (1.7%) were present as coatings on individual silicate particles and as discrete masses of colloidal material which were removed by treatment with citrate-bicarbonate-dithionite. The quartz content of the dusts varied widely (9 to 32%) but the samples which had a common origin contained similar amounts of quartz. Values for oxygen isotope abundance of quartz isolated from the Northern Hemisphere aerosolic dust samples (mean $\delta^{18}O = 16.2$) were greater than those for the Southern Hemisphere samples (mean $\delta^{18}O = 13.5$), reflecting the metamorphic and igneous nature of the source materials on the Australian continent. Five of the seven aerosolic dusts and a Hawaiian soil contained ^{137}Cs. The specific activity of ^{137}Cs ranged from 0 pCi in dusts from a Greenland ice core and a mud-rain from England, and a pelagic sediment to 264 pCi in a dust high in micaceous vermiculite obtained from melted ice on the Franz Josef glacier in New Zealand. All of the samples sorbed significant amounts, approximately 30 to 50%, of the ^{137}Cs added in solution (carrier-free) and, moreover, most of this ^{137}Cs became fixed against replacement with 0.01 N $CaCl_2$. Approximately 80% of the ^{137}Cs on the FJ-II sample (no ^{137}Cs added) was also fixed against replacement in 0.01 N $CaCl_2$. The addition of aerosolic dusts containing little weathered minerals to soils, particularly to soils which are strongly weathered and highly leached, is a soil rejuvenating process. Aerosolic dusts, which contain micaceous vermiculite, can scavenge ^{137}Cs during transport in the troposphere and presumably also ^{137}Cs added to soil in rainfall following deposition of the dusts as soils or sediments. The ^{137}Cs is tightly held by the micaceous vermiculite component of the dusts against replacement by Ca. (auth)

25574 FUTURE OF RADIOACTIVE MATERIALS IN A TORNADO. DeWhitt, Everett Lavern Jr. Norman, Okla.; Univ. of Oklahoma (1971). 72p. University Microfilms Order No. 72-9028.

Thesis.

The behavior of radioactive particulate material incorporated into a tornado vortex is hypothesized. A general description of the tornado is included with evidence of the probability for a tornado strike. From the literature concerning tornado mechanics, component velocity profiles were obtained. The method of generation for air parcel trajectories is explained and a sample mapping is included. The air parcel trajectories were utilized to estimate interim movement of the particulate material. The effect of tornadic winds upon isotope containment devices is considered. Failure of containment due to the wind-pressure explosive effect is found to be a significant problem. The result of containment apparatus becoming a tornado borne missile is shown to be release of activity into the environs. This release of contaminants is primarily caused by the tremendous energy expended upon impact. A means of generating deposition areas for heavy contaminated debris is discussed. By utilizing maximum projectile characteristics, limiting distances can be calculated which will determine the boundaries of tornado transport. The single reconcentrating factor of the severe storm system is precipitation. Rainfall contours are found to be the best estimate of deposition for small particulate materials. A combined mapping of these two deposition patterns is presented for a tornado incident at a hypothetical nuclear facility. The absence of definitive vortex modeling and the constantly changing geometry of each vortex are shown to prevent exact prediction of the ultimate fate for tornado-borne materials. Attempts to model air movement, on the micro-meteorological scale necessary, were proven hazardous due to the individuality of each tornado and the unique structure for each nuclear facility. With presently available knowledge, the estimates remain qualitative in nature. Thus from the radiological health viewpoint, the nuclear facility should be constructed to withstand the tremendous forces of the tornado. (Diss. Abstr. Int., B)

25575 DISCOVERY OF ^{181}W AND ^{185}W IN FALLOUT. de Franceschi, L.; Gentili, A.; Gremigi, G.; Guidi, P. (Servizio Fisica Sanitaria, Pisa, Italy). Minerva Fisiconucl.; 15: No. 1, 20-7(Jan-Mar 1971). (In Italian).

Monitoring of radioactivity in the atmosphere is done routinely at all European nuclear centers. Any sharp increase must be investigated and its origins sought. For this reason the high values during Dec. 18 to 20, 1968 led to the unusual discovery of W isotopes on the atmospheric dust filters and in the fallout. The salient phases of the operation and the techniques used are described. Some hypotheses relative to the discovery are advanced. (tr-auth)

25576 DATA. SECTION III. AIR AND DEPOSITION. Radiat. Data Rep.; 13: No. 1, 42-6(Jan 1972).

Data are presented from Sept. 1971 measurements of the gross beta radioactivity in the surface atmosphere and in atmospheric precipitation at 70 US sampling stations and 24 Canadian locations and in the surface atmosphere at 12 Pan American sampling stations. (L.C.L.)

25577 DATA. SECTION IV. OTHER DATA. Radiat. Data Rep.; 13: No. 1, 47-55(Jan 1972).

Data are presented on radiation monitoring activities in the environs of the Argonne National Laboratory from July through Dec. 1970. Included are data on: the alpha, beta, and gamma radioactivities in samples of surface-level atmosphere; ^{41}Ar content in atmosphere; tritium content in atmosphere; alpha and beta radioactivity in Sawmill Creek water; beta-emitting radioisotopes in Sawmill Creek water; tritium and U content and average radioactivity in Des Plaines and Illinois River waters; radioisotope content of Des Plaines River water; and ^{137}Cs and ^{90}Sr content in area milk. (L.C.L.)

25578 DATA. SECTION III. AIR AND DEPOSITION. Radiat. Data Rep.; 13: No. 2, 82-98(Feb 1972).

Gross beta radioactivity data are presented for: Oct. 1971 measurements in ground-level atmosphere and atmospheric precipitation at 70 US and 24 Canadian sampling stations; Oct. 1971 measurements in the ground-level atmosphere at 12 Pan American and 14 Californian sampling stations; and July 1971 measurements in ground-level atmosphere at 103 stations in 21 of the western US states. Additional data are tabulated from 1969 fallout monitoring of the ground-level atmosphere at 21 sampling stations of the 80th Meridian Network. The radioisotopes measured were ^{144}Ce, ^{137}Cs, ^{238}Pu, ^{239}Pu, ^{89}Sr, ^{90}Sr, and ^{95}Zr. (L.C.L.)

25579 DATA. SECTION IV. OTHER DATA. Radiat. Data Rep.; 13: No. 2, 99-112(Feb 1972).

Data are presented on: 1968 through 1970 measurements of the ^{90}Sr content of vertebrae from humans in New York City and San Francisco; Jan. to July 1966 measurements of the gross beta radioactivity and ^{131}I and ^{133}I content of milk and drinking water samples from the Nevada Test Site area; environmental radiation monitoring during Jan. to July 1971 near Atomics International (Calif.) and the Portsmouth Plant (Ohio); and 1970 measurements of the gross beta radioactivity in atmospheric precipitation and ground-level atmosphere at Los Alamos. (L.C.L.)

25580 GAMMA SPECTROMETRY OF FALLOUT CAUSED BY FRENCH ATOMIC BOMBS IN 1968. Meyer, E. (Comissao Nacional de Energia Nuclear, Rio de Janeiro). An. Acad. Brasil. Cienc.; 43: No. 2, 331-43(30 Jun 1971). (In Portuguese).

Systematic air sampling and total beta counting were undertaken in Rio de Janeiro in order to detect new fallout produced by nuclear explosions. However, due to limitations in the equipment, the decision to perform the gamma analysis was made 6 months after the 1968 French explosion occurred. Gamma spectrometry was accomplished by using a 512 channel analyzer and a NaI (Tl) 3'' × 3'' detector. Using an experimental technique to eliminate or reduce the recent fallout gamma contribution of the fallout produced by previous tests, allowed a "cleaner" spectrum to be obtained with the characterization of a new total absorption peak. This new peak reveals the presence of a nuclide which was not previously detected in the radioactive fallout. The new total absorption peak refers evidently to ^{175}Hf induced by neutrons in nuclear explosions carried out in 1968. (auth)

25581 DETERMINATION OF THE COEFFICIENT OF DIFFUSION BY THE METHOD OF RADIOACTIVE TRACERS. Amiranashvili, A. G.; Okroashvili, G. G.; Khundzhua, T. G. (Inst. of Geophysics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 65: No. 3, 575-7(Mar 1972). (In Russian).

The distribution law of radioactive impurities in an anisotropic medium from instantaneous point source was established, and a

formula for determining the coefficient of diffusion was obtained in general form. The values of concentrations of radioactive impurities in the medium (atmosphere) serve as the experimental basis for calculating the coefficient of diffusion. (auth)

Soil

Refer also to abstract 25246.

25582 IMMOBILIZATION OF RADIOSTRONTIUM IN SOIL BY PHOSPHATE ADDITION. Kunishi, H. M.; Taylor, A. W. (Dept. of Agriculture, Beltsville, Md.). Soil. Sci.; 113: No. 1, 1-6(Jan 1972).

Alkaline orthophosphate salts can be used to immobilize up to 98% of the calcium and strontium ions in the upper layers of soil, when applied in sufficient quantity to the surface of the undisturbed soil. The addition of smaller amounts of fluoride with the phosphate enhances the reaction and reduces the amount of phosphate needed. Equilibration of treated samples for up to 110 days showed that there is little change in the amount of strontium immobilized after the initial reaction. The effect of supplemental additions of lime, to replace the original calcium and to prevent redissolution of the reaction products as the soil pH tended to fall, differed in the two soils examined. In Cecil soil, with low initial calcium and low buffering capacity, liming increased the immobilization. In Brookston soil, with high initial calcium and stronger buffering capacity, liming reduced immobilization somewhat, although over 90% of the radiostrontium remained fixed. The reasons for these differences are obscure and further investigation of the reactions on a wide range of soil types is needed before any detailed interpretation can be made. The ultimate choice of the phosphate salts will be among sodium, potassium and ammonium. The sodium salt has the disadvantage that the resulting exchangeable sodium will make the soil unstable and will be removed only by leaching into the profile. The advantages of the ammonium salt are that it is widely available as a commercial material and will be removed from the soil by plant uptake and nitrification so that, with the addition of lime, the soil will revert to a more normal, albeit calcareous, condition. Another advantage of the ammonium salt is that, although apatite is the ultimate stable phase that must be formed, other insoluble calcium-ammonium phosphates, including $Ca(NH_4)PO_4 \cdot H_2O$ and $Ca_2(NH_4)_2(HPO_4)_3 \cdot 2H_2O$, may be formed as intermediates that will also decrease the available calcium and strontium. Except for its ready removal from the soil, many of the advantages of the ammonium salt may also be exhibited by potassium, including the formation of the calcium-potassium analogs of the insoluble calcium-ammonium phosphates. The value of the potassium salt is offset, however, by the limited amounts that are likely to be readily available. The higher atomic weight of the potassium ion will also increase the bulk of material required to produce the same result. For these reasons no work was done with potassium phosphates, but the value of mixtures of potassium and ammonium salts merits further examination. (auth)

25583 RAPID AND ACCURATE METHOD OF ESTIMATING SOIL CONCENTRATIONS OF GAMMA EMITTING ISOTOPES. Mishra, U. C.; Sadasivan, S. (Bhabha Atomic Research Centre, Trombay, India). pp 39-48 of Radiation and Radioisotopes in Soil Studies and Plant Nutrition. Bombay; Dept. of Atomic Energy (1971).

From Symposium on radiation and radioisotopes in soil studies and plant nutrition; Bangalore, India (21 Dec 1970). See CONF-701227.

A nondestructive method for gamma spectrometric estimation of fallout radioisotopes (^{144}Ce, ^{137}Cs, ^{54}Mn, ^{125}Sb, and ^{106}Ru) and naturally-occurring K, Th, and U isotopes in countrywide soil samples is described. The method is suited for estimating the ^{232}Th and ^{238}U content of undisturbed soil samples and the ^{226}Ra and ^{228}Th concentrations in disturbed soils. In the method, soil samples are collected, dried, powdered, sieved, and stored in leakproof containers for 1 month. Standard sources are prepared in identical containers using sodium oxalate as the blank and adding known activities of various isotopes to it. A NaI(Tl) counter, coupled to a 256-channel pulse height analyzer, was used to count and print the gamma spectra for both the sample and standard sources. The data were processed to convert the gamma energy readings for the various isotopes present in the sample to isotope content values. The method provides a convenient method for measuring gamma emitting isotopes in soil samples, for studying their depth distributions and time variations, and for studying their movement from soils to plants. (L.C.L.)

25584 STUDIES ON THE LEACHING OF RADIOSTRONTIUM THROUGH TYPICAL SOILS. Bhujbal, B. M ; Mistry, K. B. (Bhabha Atomic Research Centre, Trombay, India). pp 49-62 of Radiation and Radioisotopes in Soil Studies and Plant Nutrition. Bombay; Dept. of Atomic Energy (1971).

From Symposium on radiation and radioisotopes in soil studies and plant nutrition; Bangalore, India (21 Dec 1970). See CONF-701227.

Experiments were performed to evaluate the effects of leaching with deionized water, 0.005N $CaCl_2$, and 0.005N NaCl on the quantity of ^{89}Sr removed from a contaminated layer of soil and on the vertical movement of ^{89}Sr in soil columns. The results indicated that some of the treatments employed can result in the leaching of significant quantities of radiostrontium out of the contaminated soil layer. The EDTA and moderately high calcium irrigation water treatments also lead to considerable vertical movement of the nuclide in the soil profiles. However, it is noteworthy that under conditions of the present study, which involved leaching of large volumes of solutions over prolonged periods, the maximum depth to which radiostrontium was moved was 15 cm. It is clear, therefore, that while dealing with an actual situation which requires decontamination of the surface soil layer the leaching treatments would have to be combined with other measures such as plowing under of the top soil. Further, in order to minimize the radioactive contamination of the food chain these measures should necessarily be combined with application of lime and organic matter to soil in the root zone which leads to reduced uptake of radiostrontium by crop plants. (L.C.L.)

Water

Refer also to abstract 25603.

25585 (FRL-8) RADIOACTIVITY IN SURFACE AND COASTAL WATERS OF THE BRITISH ISLES, 1970. Mitchell, N. T. (Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Radiobiological Lab.). Dec 1971. 38p. Dep. NTIS (U. S. Sales Only).

The results of monitoring the aquatic environment for the control of radioactive waste discharges, primarily in England and Wales, are reported and surveys made during 1970 are described. Accounts of surveys and monitoring in Scotland, the Channel Islands States, and the Irish Republic are also given. Most of the surveys are specifically linked to planned discharges within the United Kingdom from sites of the United Kingdom Atomic Energy Authority. Data are also given for seaweeds, sand, fish flesh, and silts. The results confirmed that adequate control of radioactive waste disposal has been maintained throughout 1970. (P.C.H.)

25586 (RLO-1750-80) VERTICAL DISTRIBUTION OF RADIOACTIVITY IN THE COLUMBIA RIVER ESTUARY. Hanson, Peter James (Oregon State Univ., Corvallis). Jun 1967. 86p. Dep. NTIS.

Thesis.

In situ salinity, turbidity, and temperature were measured at discrete depths and water samples for radioanalysis were simultaneously collected in the Columbia River estuary using a specially designed instrument package. Particulate radioactivity was concentrated by filtration and the dissolved radioactivity by evaporation or ferric oxide bulk precipitation. Radioanalysis was by gamma-ray spectrometry and data reduction by computer. Chromium-51 was mostly dissolved and conservative in brackish water, while zinc-65 was mostly particulate and non-conservative. The intrusion of salt water into the estuary was seen to greatly increase the concentrations of particulate chromium-51, zinc-65, and scandium-46 near the bottom. The fall and rise in estuarine radioactivity levels were followed during an infrequent pause in Hanford reactor operations. Changes in radioactivity levels of up to three orders of magnitude were recorded at Astoria, Oregon, some 380 miles from the reactors. The pause in reactor operations enabled the determination of river flow times from the reactors to Astoria. Flow times of 12 and 19 days were measured for average river discharges of 290,000 and 130,000 cfs, respectively. (auth)

25587 (RLO-1750-83) NON-BIOLOGICAL UPTAKE OF ^{65}Zn FROM A MARINE ALGAL NUTRIENT MEDIUM. Tomlinson, Richard Douglas (Oregon State Univ., Corvallis). Sep 1970. 73p. Dep. NTIS.

Thesis.

The nature and magnitude of experimental errors due to ^{65}Zn adsorption by inorganic surfaces was examined in a laboratory system designed to measure ^{65}Zn uptake by marine phytoplankton. In the pH range of 6.3 ± 0.1 to 7.5 ± 0.1, a precipitate formed in the algal nutrient medium selected for the system. To this seawater-base medium, zinc was added only as carrier-free ^{65}Zn. The precipitate increased in both volume and tendency for ^{65}Zn uptake as the pH increased. At a pH of 7.5 ± 0.1 the particles, predominantly orthophosphates, accumulated 70 percent of the ^{65}Zn in the medium in 24 hours. It was therefore concluded that ^{65}Zn adsorption by undetected precipitates could result in serious

errors in measurements of ^{65}Zn uptake by marine phytoplankton. Equilibrium of ^{65}Zn adsorption by Pyrex glass surfaces was attained between 0.50 and 2.0 hours elapsed time. Found to be negligible at pH values less than 6.0 ± 0.1, such uptake was a linear function of the hydrogen ion concentration in the pH range of 6.7 ± 0.1 to 8.2 ± 0.1. Pretreatment of the glass surfaces with dimethyldichlorosilane (General Electric "Dry Film") reduced ^{65}Zn adsorption by over 80 percent. The relationship between percent ^{65}Zn sample adsorption and wetted glass surface area/pipette sample volume was found to be linear for volumetric pipettes of the size range, 1 to 15 ml. At a pH of 7.5 ± 0.1, ^{65}Zn adsorption was negligible for most laboratory glassware, but increased with pH. At a pH value of about 8.0, glassware having surface area/sample volume ratios as small as those of 15 and 20 ml volumetric pipettes adsorbed 7 to 11 percent of the contained sample activity. Two prerinses with the sample liquid were required to reduce such errors by a factor of one-half. (auth)

25588 EXCESS-RADON AND TEMPERATURE PROFILES FROM THE EASTERN EQUATORIAL PACIFIC. Chung, Yu-chia; Craig, Harmon (Univ. of California, San Diego, La Jolla). Earth Planet. Sci. Lett.; 14: No. 1, 55-64(Feb 1972).

A series of excess-radon and continuous temperature profiles in bottom water of the eastern equatorial Pacific was measured on the SCAN Expedition. The results show that the temperature profiles have many characteristics which correlate with the radon profiles and provide important information on the nature of the bottom water processes. Highest model diffusivities for radon were encountered in regions where the temperature gradient was adiabatic; in constant diffusivity models these parametric values are about 200 cm^2/s, as compared with more generally observed values which are a factor of 10 lower. Four types of radon profiles are described: quasi-exponential, layered, cascade-type, and cusp-type profiles. (auth)

25589 EVALUATION OF TRITIUM IN GROUND AND SURFACE WATERS OF THE WESTERN UNITED STATES, APRIL 1968–DECEMBER 1969. Mullins, James W.; Stein, John L. (Western Environmental Research Lab., Las Vegas, Nev.). Radiat. Data Rep.; 13: No. 2, 59-67(Feb 1972).

In order to establish a baseline for environmental tritium so that any future deviations could be evaluated, a study was conducted to measure current levels of tritium in ground and surface waters of the Western United States. Data are reported for tritium concentrations in surface and ground waters during Apr. 1968 through Dec. 1969 in the Western United States including Alaska and Hawaii. Samples were collected by State public health agencies and mailed to the Western Environmental Research Laboratory where they were analyzed by liquid scintillation techniques. The concentration of tritium was nondetectable in most ground water samples, while other samples contained as much as 2.6 nCi/liter. Surface water samples ranged from nondetectable to 3.8 nCi/liter. Possible reasons for the range of results, such as altitude and latitude effects, are discussed. (auth)

25590 DATA. SECTION II. WATER. Radiat. Data Rep.; 13: No. 1, 37-41(Jan 1972).

Data are presented on the gross alpha and beta radioactivities in US surface waters from April and May 1971. The rivers monitored included the: Cheyenne, Clinch, Great Miami, Kentucky, Licking, Little Miami, Mississippi, Missouri, Ohio, Roanoke, Susquehanna, Tennessee, White Water, and Yellowstone. 1969 measurements of gross alpha and beta radioactivities in Florida surface water are tabulated. (L.C.L.)

25591 DATA. SECTION II. WATER. Radiat. Data Rep.; 13: No. 2, 79-81(Feb 1972).

Tabulated data are presented on the gross alpha and beta radioactivity measured for water samples collected during June 1971 from 31 rivers in the USA. (L.C.L.)

25592 CONTEMPORARY SOURCES AND GEOCHEMISTRY OF TRITIUM IN THE GULF OF MEXICO AND ITS DISTRIBUTIVE PROVINCE. Kincaid, George Preston Jr. College Station, Tex.; Texas A and M Univ. (1971). 257p. University Microfilms Order No. 72-5683.

Thesis.

The reaction $^{14}N(n,T^{12}C$ has been studied and the activation cross section measured at about 40 millibarns. This cross section was applied to tritium production in the Texas A&M University MTR-type nuclear reactor. An estimated tritium inventory of the reactor pool water indicated that at least 98% of the tritium produced was lost from the reactor pool to the environment. Water, and water from plant samples, collected near the reactor showed no correlation with the tritium activity of reactor pool water. These water samples reflected the aftereffects of the annual spring leak of tritium for the year 1967; i.e., the tritium activity decreased slowly during the sampling period (June through December). A system was developed for the low-level counting of aqueous tritium samples by liquid scintillation spectrometry. To optimize conditions for low counter background, shielding was important both above and below the counter. Plastic vials give the best all-around performance for the low-level counting of aqueous tritium samples, and the methods of handling and moving the vials are important. A toluene-based counting solution was studied that is in many ways superior to those used previously for this type of work. A procedure for rapidly screening the tritium activities of natural water samples was studied. Direct counting of water, which requires negligible processing time for samples, is adequate for samples containing tritium activities as low as about 400 T.U. In the tritium activity range of 100 to 400 T.U., an isotope exchange technique that requires about 3 days of sample-processing time is adequate. Electrolytic enrichment techniques are necessary for lower tritium activities, especially those of sea water samples—the processing time for such samples is on the order of 20 days. The screening procedure can be used to determine quickly the desirability and degree of sample enrichment that is necessary for a given suite of water samples. The electrolytic enrichment technique has been evaluated thoroughly, and several innovations added: (1) a flow of argon gas is led through the enrichment cells to preclude possible contamination of the sample undergoing electrolysis, and to sweep from the cell the explosive, electrolytically-generated mixture of hydrogen and oxygen; (2) the electrodes have been anchored rigidly in place by means of nylon bolts and nuts, with extremely reproducible geometry; and (3) in addition to the normal electrodes, large surface-area electrodes were built and placed in specially enlarged electrolysis cells. A constant current density was maintained on all electrodes during electrolysis runs. When the efficiency of electrolysis was used to analyze the performance of electrodes the results indicated that the enrichment of tritium is reproducible over a wide range of volume reductions, regardless of electrode size, and that all electrode pairs behave in an identical manner. The oceanographic phase of the research showed that the Subtropical Underwater is the major source of tritium in the western Gulf of Mexico. This water mass carries the tritium to the Yucatan Strait, and then to the western Gulf. The physical properties of the water mass that extends from the surface to the depth of the Subtropical Underwater, and the tritium content, are modified by mixing processes as the water moves westward. The integrated tritium content of the water column, to a depth of 150 m, is higher in the western Gulf than in the Yucatan Strait. This excess is due to the input of tritium from runoff and rainfall. A 2-box model was developed for the mixing and exchange of water masses in the upper layers of the Gulf of Mexico. This box model was used to derive a formula from which the residence time of water in the upper 150 m of the western Gulf can be calculated. The estimated residence time calculated from this formula, through a short series of approximations, was 3.5 to 6 years. (Diss. Abstr. Int., B)

Ecosystems and Food Cycles

Refer also to abstracts 25602, 25609, 25791, 25800, 25891, 25907–25910, and 27610.

25593 RADIOECOLOGICAL CHARACTERISTIC OF THE MAIN COMPONENTS OF VEGETATION COVER OF THE LATVIAN SSR MEADOWS AND PASTURES. Shalaeva, T. V.; Sabardina, G. S. Latv. PSR Zinat. Akad. Vestis; No. 11, 41-6(1971). (In Russian).

Radiochemical studies were made that allowed the establishment of the dynamics of strontium-90 and cesium-137 accumulation in the basic species of grassland vegetation in Latvia in 1964, 1965, and 1967. The studies showed a gradual decrease in radioactive substances from year to year. The soil humidity affects the strontium-90 and cesium-137 content in grassland vegetation. With an increase in the soil humidity, the content of strontium-90, and especially that of cesium-137, increases in the plant mass. Various combinations of pH with the organic matter in soils favor strontium-90 alterations in grassland plants. Strontium-90 concentration in grassland plants depends on their species. Leguminous plants (as shown in the example of Trifolium pratense) accumulate strontium-90 far more than species of other families. The established regularities of strontium-90 and cesium-137 accumulation by grassland vegetation depend on the growth conditions (effects of organic matter, soil pH, and humidity). The plant specific differences give an opportunity to determine the potential extent of grassland radioactive contamination in Latvia according to the ecological conditions. (auth)

25594 EVALUATION OF INTERNAL RADIATION DOSES TO MEMBERS OF THE PUBLIC RESULTING FROM CONTAMINATION OF FOOD BY ^{90}Sr AND ^{137}Cs IN RELATION TO THE DETERMINATION OF THE LEVELS OF DISCHARGE OF RADIONUCLIDES INTO THE ENVIRONMENT. Garnier, Arlette (CEA, Fontenay-aux-Roses, France). Health Phys.; 22: No. 3, 267-7(Mar 1972). (In French).

A study was made of models for the determination of levels of discharge of radioactive substances into the environment. It was proposed to estimate the average internal radiation dose resulting from contamination of the food chain by ^{90}Sr and ^{137}Cs, taking account of: the conditions and transfer mechanisms of the environment, the various links in the food chain, and the characteristics of the population groups concerned (age, diet, and anatomical and physiological parameters). The parameters used in the models were chosen either by bibliographical reference or after the results of experimental studies or inquiries (such as those of the weights of the components of family diets). The effect of the variation of these factors was not studied, the influence of the diet only being dealt with, and, particularly, with the influence of the pattern of addition and removal of radionuclides in the environment associated with the influence of the age at which the individuals became subject to internal contamination. (auth)

25595 FALLOUT ^{137}Cs ACCUMULATION IN TWO ADJACENT POPULATIONS OF NORTHERN CALIFORNIA DEER. Book, S. A. (Univ. of California, Davis); Connolly, G. E.; Longhurst, W. M. Health Phys.; 22: No. 4, 379-85(Apr 1972).

Fallout ^{137}Cs levels were determined in rumen contents and muscle from 68 wild Columbian black-tailed deer (Odocoileus hemionus columbianus) collected during 1967 to 1969 near Hopland, California. Rumen contents only were obtained from 20 additional animals. Variations in ^{137}Cs burdens of deer living in close proximity within oak woodland and chaparral habitats were studied in relation to food habits and foliar contamination by the radionuclide. Samples from deer collected from the oak woodland contained higher concentrations of ^{137}Cs in all seasons than did samples from deer living in the chaparral. Oak woodland deer ate appreciable amounts of lichens at all seasons; these lichens contained up to 140 times the ^{137}Cs activity of other forage. (auth)

25596 RADIOLOGICAL PROTECTION OF MEMBERS OF THE PUBLIC: A DISCUSSION OF THE PROBLEMS PRESENTED, EXISTING SOLUTIONS, AND FUTURE PROSPECTS. Lacourly, G. (CEA, Fontenay-aux-Roses, France). Health Phys.; 22: No. 3, 279-85(Mar 1972). (In French).

The dose delivered to a critical population group is evaluated by calculations that involve a number of hypotheses and parameters. The problems of evaluation are discussed. To make the monitoring convenient, limiting levels or guide levels are established applicable to the receiving medium or to the discharged waste itself. When the dose originates from several radionuclides emitted from several sources, the establishment of limiting levels must take account on the one hand of the contribution to the dose from those different radionuclides and different sources and on the other hand of the capacity of the environment to accept these radionuclides. The most practicable solution is to express the derived levels as percentages of the dose limit for members of the public. For the operator, who needs to know the levels of different radioelements that he must not exceed, the activity per unit time in the discharge remains the best form of guide level. The whole problem thus reduces to the establishment of a table of correspondence between the two systems of units for each discharge. (auth)

25597 DATA. SECTION I. MILK AND FOOD. Radiat. Data Rep.; 13: No. 1, 27-36(Jan 1972).

Tabulated data are presented for Oct. 1970 to Oct. 1971 measurements of the ^{137}Cs and ^{90}Sr content of pasteurized milk samples from 63 US, 14 Canadian, and 7 Central and South American sampling stations and for Sept. 1971 measurements of the ^{89}Sr content in milk from 7 stations in Tennessee, Chile, Colombia, Ecuador, and Venezuela. (L.C.L.)

25598 DATA. SECTION I. MILK AND FOOD. Radiat. Data Rep.; 13: No. 2, 69-78(Feb 1972).

Tabulated data are presented on Nov. 1970 to Nov. 1971 measurements of the ^{137}Cs and ^{90}Sr content in pasteurized milk samples from 63 US, 16 Canadian, and 7 Central and South American sampling stations, and from Oct. 1971 measurements of the ^{89}Sr content of pasteurized milk at 4 stations in the US, Chile, and Ecuador and of the ^{140}Ba content of milk samples in Kansas. (L.C.L.)

25599 RADIOACTIVE CONTAMINATED LICHENS AND THE PECULIAR IMPORTANCE FOR RADIOLOGIC HYGIENE. Keil, R.; Randow, F.; Schulze, H.-A.; Fleischer, I. (Univ., Rostock, Ger.). Z. Gesam. Hyg. Ihre Grenzgeb.; 16: 898-902(Dec 1970). (In German).

On the basis of literary data, the author discusses the contamination of plants of the polar zone, above all, of lichens, by fallout radionuclides and their inclusion in the terminal nutritional chain of man (Laplanders and Eskimoes). As was revealed by studies on some lichen species on different sites in the region of the Baltic Sea Coast, there was a ^{90}Sr-contamination ranging from 0.01 to 0.03 nCi/g ashes or 1.1 to 2.4 nCi/kg (dry weight) and ^{137}Cs-contents ranging from 0.08 to 0.91 nCi/g ashes or 8.1 to 38.1 nCi/kg. These results are compared with findings from Lapland and Alaska. (auth)

25600 DISTRIBUTION OF RADIOACTIVE AND STABLE ZINC IN AN EXPERIMENTAL MARINE ECOSYSTEM. Cross, Ford A.; Willis, James N.; Baptist, John P. (National Marine Fisheries Service, Beaufort, N. C.). J. Fish. Res. Board Can.; 28: No. 11, 1783-8(Nov 1971).

The distribution of radioactive and stable Zn in an experimental marine ecosystem is described. 1 mCi of ^{65}Zn was added to 2000 liters of seawater and a mixed community of planktonic and benthic algae in a fiberglass tank, after which the ecosystem was left undisturbed for 9 months. The ^{65}Zn specific activities for particulate Zn (0.45 μ filterable), extractable Zn (from water passed through a 0.45-μ filter and then treated with dithizone), total dissolved Zn (from samples passed through a 0.45-μ filter and treated with acid prior to extraction with dithizone), and dialyzable were then measured. ^{65}Zn specific activities were not significantly different among the extractable, dialyzable, or acid-treated samples of the water. Further, absolute concentrations of ^{65}Zn and total Zn were no higher in the acid-treated samples than in the extracted or dialyzed samples, which indicates that nearly all of the soluble Zn in the water was dithizone-extractable and dialyzable. ^{65}Zn specific activities were significantly less, however, in the particulate material than in the water. This difference indicates that equilibrium of Zn between particulate material and water had not been reached after 9 months. Three months later (Dec. 1969) ^{65}Zn specific activities were determined again for particulate material and total dissolved Zn. The mean specific activity of ^{65}Zn in the particulate samples showed a small but significant increase, but it was still less than in the water. Concentration factors in the particulate matter were 980 for ^{65}Zn and 1400 for total Zn. Samples of benthic algae taken in Mar 1970 had a mean specific activity of ^{65}Zn similar to the mean ^{65}Zn specific activity of water samples taken 3 months earlier. (auth) (Canada)

25601 AN INVESTIGATION INTO THE DISTRIBUTION OF URANIUM AND DAUGHTERS IN THE ENVIRONMENT OF A URANIUM ORE PROCESSING FACILITY. Iyengar, M. A. R.; Markose, P. M. (Bhabha Atomic Research Centre, Trombay, India). pp 143-53 of Radiation and Radioisotopes in Soil Studies and Plant Nutrition. Bombay; Dept. of Atomic Energy (1971).

From Symposium on radiation and radioisotopes in soil studies and plant nutrition; Bangalore, India (21 Dec 1970). See CONF-701227.

Tabulated data are presented from the monitoring of radioactivity in soil, water, air, foodstuffs, and vegetation near the uranium mining and processing facility at Jaduguda, Bihar (India). The concentration of activity in soil patches adjacent to the river banks on the mill and mine premises was evident from the study. Air activity due to radon was found to be significantly higher than in Trombay and Alwaye, the two other centers handling considerable quantities of uranium-bearing ores. Water activity was found to vary widely depending on its radionuclide content. The wide range of concentration in foodstuffs is perhaps due to the varying radioisotope concentrations in different media. The hazards of utilizing the mine stream for domestic cultivation of vegetables and fishing were demonstrated. Algae is a good indicator organism in water pollution. The foodstuffs survey has not led to any selective indicator to aid in the radiological monitoring program. (auth)

Radiometric Techniques

Refer also to abstracts 25504, 25592, and 25651.

25602 (CONF-701227) RADIATION AND RADIOISOTOPES IN SOIL STUDIES AND PLANT NUTRITION. Proceedings of a Symposium held at The University of Agricultural Sciences, Hebbal, Bangalore, December 21–23, 1970. (Department of Atomic Energy, Bombay (India). Food and Agriculture Committee). 1971. 474p.

Forty-one papers on uses of radiation and radioisotopes in plant nutrition and soil studies were presented at the conference. A separate abstract was prepared for each of 7 papers. Thirty-four papers were not within the scope of NSA. (auth)

For abstracts of individual papers see: 25583, 25584, 25601, 25744, 25905, 25942, and 25943.

25603 (RLO-1750-70) METHODS FOR THE MEASUREMENT OF HANFORD-INDUCED RADIOACTIVITY IN THE OCEAN. Osterberg, Charles L. ([Oregon State Univ., Corvallis. Dept. of Oceanography]). [nd]. 36p. Dep. NTIS.

The chronological development of equipment and methods for measuring low-level radioactivity in the sea are described. This development was pursued in order to trace the long-distance diffusion of radioisotope-containing plumes from the Columbia River in the Pacific Ocean. ^{51}Cr and ^{65}Zn isotopes in the Columbia River plume were of particular interest for use as tracers. The methods discussed included the use of biological monitors, in-situ radioactivity monitoring of seawater and bottom sediments, and radiochemical analysis of seawater. The advantages and disadvantages of each method, the development and performance of equipment required for each method, and the current status of this research are discussed in detail. (L.C.L.)

25604 THERMOLUMINESCENCE FROM UNIRRADIATED FLINTS: REGENERATION THERMOLUMINESCENCE. Goeksu, H. Y.; Fremlin, J. H. (Univ. of Birmingham, Eng.). Archaeometry; 14: No. 1, 127-32(Feb 1972).

The spurious thermoluminescent glow from ground samples of flint is responsible for dating errors in the region of 10,000 years for grains less than 45 μm diameter or of 4000 years for larger grains. The glow is partly tribothermoluminescence and partly regeneration thermoluminescence, and the conditions in which these arise or are accelerated were investigated. It is shown that if thin polished slices are used, rather than powder, the amount of such glow is negligible. (auth)

25605 POTASSIUM ARGON DATING OF GAMMA-IRRADIATED MINERALS. Mitchell, J. G. (Univ. of Newcastle-upon-Tyne, Eng.). Earth Planet. Sci. Lett.; 14: No. 1, 91-6(Feb 1972).

A method for measuring argon/potassium ages making use of the reaction $^{39}K(\gamma,n)^{38}K^{\beta+} \rightarrow {}^{38}Ar$ to indirectly determine potassium is discussed. In principle, it is closely analogous to the $^{40}Ar/^{39}Ar$ dating method and should possess all of the attributes of that technique. It is demonstrated that precise dating of mica samples with ages between 15 and 1000 My can be carried out, and a discussion of potentially interfering reactions suggests that it may be possible to extend the method to the problem of induced argon isotopic dating of calcium-rich minerals. (auth)

25606 DETERMINATION OF LINEAR AND MASS COEFFICIENTS OF GAMMA-RADIATION ABSORPTION BY CHROMITES. Malakhov, G. M.; Azaryan, A. A. Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 8, 759-61(Sep 1971). (In Ukrainian).

The experimental and estimated value is given for the coefficient of gamma radiation absorption by chromites, depending on the gamma-source energy, material composition, and density of ores and rocks. The optimum range of the gamma-source energy is determined for sizing and dressing chromites of various types. (auth)

Site Surveys

Refer also to abstracts 25518, 25556, 25567, and 25568.

25607 (WASH-1518(Dr.)) LAND ACQUISITION, ROCKY FLATS PLANT COLORADO. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Jan 1972. 23p. Dep. NTIS.

This environmental statement has been prepared to comply with the National Environmental Policy Act of 1969 and in support of the U.S. Atomic Energy Commission's proposal for legislative authorization and appropriation covering acquisition of about 4,640 acres of land surrounding its existing Rocky Flats Plant. The Rocky Flats Plant is a key facility for the fabrication of plutonium components for nuclear weapons, and is therefore an integral part of the national security program. It is located approximately 10 miles straight-line south of the Boulder County Court House and 16 miles straight-line northwest of the Denver City and County Building. The plant site comprises about 2,520 acres of land situated roughly in the center of a presently rural and largely undeveloped 15-square-mile area. This additional 4,640 acre land area will provide a one to one-and-one-half mile buffer zone around an existing, aesthetically unattractive industrial facility. This facility represents a large capital investment. Although the land to be acquired is presently being utilized primarily for grazing purposes, it is evident that it is on the verge of being developed for residential and industrial uses. It is hoped that Government acquisition of the buffer zone will serve to minimize the types of problems that often arise from proximity of industrial facilities to residential communities. This buffer zone would be developed as a greenbelt around the industrial facility, which would be desirable in the potentially high-density residential area and would further the recommendations of the Colorado State Environmental Commission. This greenbelt would preserve and enhance the ecological state of the land. Shelter belts would be added in the form of alternate rows of shrubs, bushes, and trees. These shelter belts should upgrade the aesthetic quality of the area, significantly decrease wind and water erosion, encourage increased growth of vegetation, and provide shelter for animal life. The buffer zone would also provide an additional margin of safety in the event of a plant accident, which, although extremely unlikely, cannot be statistically ruled out. There do not appear to be any adverse environmental aspects to be weighed against the benefits of the proposed acquisition. The proposed action will not involve the irreversible or irretrievable commitment of any resource. (auth)

Thermal Effluents

Refer also to abstracts 25449, 27476, 27480–27482, 27493, 27507, 27514, 27515, 27520, 27522, and 27527.

25608 (HEDL-TME-71-180) THERMAL EFFECTS OF PROJECTED POWER GROWTH: MISSOURI RIVER BASIN. Peterson, D. E.; Schrotke, P. M. (Hanford Engineering Development Lab., Richland, Wash.). Sep 1971. Contract AT(45-1)-2170. 90p. Dep. NTIS.

Direct cooling capacities of the Missouri River and five tributaries downstream of Toston, Montana, a distance of 2290 river miles, were calculated for average and low flow conditions. Total assimilative and dissipative capacity ranged from a high of 300 GW_T to a low of 159 GW_T. At the 1969 average flow-through thermal rejection ratio [MW_T/MW_e] of ~1.7 for the Missouri Basin, the upper limit for direct cooled electrical generation would be 95 GW(e) at a 100% capacity factor and under low monthly conditions. Improvements in thermal efficiency may increase this limit to 110 GW(e) by 1990. Analyses of projected power generation patterns indicate that the main stem Missouri has adequate cooling capacity to accommodate forecasted loads through the year 1990. Variable cycle or closed-cycle cooling can be expected to be standard for 1980 and 1990 generating units using tributary streams as a source of condensing water supply, with the exception of the lower Yellowstone River. Regional planning of thermal releases will be especially important in the Omaha and Kansas City areas if flow-through cooling is to be utilized for 1990 requirements. (auth)

25609 (ORO-4253-1) ECOLOGICAL EFFECTS OF NUCLEAR STEAM ELECTRIC STATION OPERATIONS ON ESTUARINE SYSTEMS. Progress Report. Mihursky, J. A. (Maryland Univ., Solomons. Natural Resources Inst.). Jan 1972. Contract AT-(30-1)-4253. 172p. Dep. NTIS.

Data and information that resulted from investigative programs on phytoplankton, meroplankton, benthic animal-sediment deposits, fin fish, and miniature ecosystem models are presented. (J.R.D.)

25610 THERMAL AQUACULTURE: ENGINEERING AND ECONOMICS. Yee, William C. (Oak Ridge National Lab., Tenn.). Environ. Sci. Technol.; 6: No. 3, 232-7(Mar 1972).

Uses of power plant waste heat in agriculture and aquaculture are discussed. The status of aquaculture is reviewed. Information and data are included on aquaculture cost factors, continuous culture of shrimp, marketing, and economics. (J.R.D.)

25611 THERMAL DISCHARGES: ECOLOGICAL EFFECTS. Levin, Arthur A.; Birch, Thomas J.; Hillman, Robert E.; Raines, Gilbert E. (Battelle Memorial Inst., Columbus, Ohio). Environ. Sci. Technol.; 6: No. 3, 224-30(Mar 1972).

An evaluation of the effects of cooling water discharges on the environment and ecology is presented. Data are included on water use in the U. S. along with results of site selection studies involving installations producing waste heat. Recommendations are included for control of thermal effluents. (J.R.D.)

25612 CONDENSER COOLING AND PUMPED-STORAGE RESERVOIRS. Sefchovich, Eli. J. Power Div., Amer. Soc. Civil Eng.; 97: No. PO-3, 611-21(Jul 1971).

The feasibility of utilizing pumped-storage reservoirs to increase the supplies of cooling water for thermal power plants is investigated. An important parameter in such studies is the determination of the waste heat that can be dissipated by the lake. For illustration purposes a recent thermal site evaluation is described. The proposed impoundment is to serve as the lower reservoir of a 750 MW pumped-storage facility. In addition, the results showed that this lake can dissipate the waste heat from water-cooled nuclear plants with a total capacity of 2,750 MW.

Equivalently, fossil-fired stations with a total capacity of 4,100 MW can be accommodated by the lake. The higher thermal efficiency of fossil-fueled plants is the main reason for this difference. Also, the increase in evaporation rate resulting from these plants can be readily made up by natural inflows. Hence, significant amounts of electricity can be safely generated at the site. (Amer. Soc. Civil Eng.)

25613 LATERAL SPREADING OF HEATED DISCHARGE. Sonnichsen, John C. Jr. J. Power Div., Amer. Soc. Civil Eng.; 97: No. PO-3, 623-30(Jul 1971).

A study was performed to examine the effect of density variation on the dispersion of effluents released into a fluid field. Using existing U.S. Atomic Energy Commission facilities at Hanford, Wash., releases were made under load (heated) and no load (nonheated) conditions. Results obtained from in situ measurements indicate a substantial difference in the effective diffusion coefficient for the heated and nonheated conditions. It is proposed that an explanation of the difference observed follows from the mutual intrusion of two heterogeneous fluids. (auth)

25614 CONFLICTS IN WATER RESOURCES PLANNING. Water Resources Symposium Number Five, Austin, Texas, November 20, 1970. Gloyna, Earnest F.; Butcher, William S. (eds.). Austin, Tex.; University of Texas (1972). 180p. $15.00. (CONF-701149).

The conflicts in water resources planning are examined in an effort to development an understanding of the issues involved. Such an understanding is considered to be essential to resolving the basic conflicts. The conflicts discussed include the environmentalists vs developers, individual water users vs each other, and the demands on the budget dollar other than those for water resources planning. The material is presented in three sections which discuss: water, land, and people; the Government's role in water resources planning; and ecological or environmental issues related to water resources planning. (L.C.L.)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstract 27591.

25615 (AECL–3796) RADIATION DOSIMETRY IN WR-1 REACTOR. PART II. IONIZATION CHAMBERS. Mehta, K. K.; Stadnyk, A. M. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Jan 1972. 34p. Dep. NTIS (U. S. Sales Only). AECL $1.00.

An ionization chamber for measuring gamma-ray energy deposition in nuclear reactors was developed which is capable of continuous operation at temperatures up to at least 500°C. It is sufficiently small to be incorporated within in-core experiments with negligible flux depression. It is rugged, simple in construction, reliable, and accurate to within 5%. Gamma-ray dose rates were measured in the WR–1 reactor. The values for the center line of the fuel rod for carbon, magnesium, iron, and Zircaloy–2 are 109, 110, 104, and 114 mW g^{-1}/kW cm^{-1}, respectively. The effective value of the gamma-ray mass energy-transfer coefficient for these materials is calculated for the reactor gamma-ray spectrum; and its relation to the gamma-ray dose rate discussed. (9 figures, 5 tables) (auth)

25616 (ANU-P–534) FAST ANALOGUE PARTICLE IDENTIFIER. England, J. B. A. (Australian National Univ., Canberra. Research School of Physical Sciences). [1971]. 18p. Dep. NTIS (U. S. Sales Only).

A description is given of the design and performance of a high stability four quadrant fast multiplying integrated circuit particle identifier. The unit is self gating, making input coincidence requirements unnecessary. The overall delay in the identifier is measured to be 150 ns, about 10 times faster than the best commercial unit. (auth) (Australia)

25617 (ANU-P–541) REDRIFT TREATMENT OF RADIATION DAMAGED Si(Li) DETECTORS. Merrill, N. H.; Thomas, D.; Whineray, S. (Australian National Univ., Canberra. Research School of Physical Sciences). [1968]. 9p. Dep. NTIS (U. S. Sales Only).

Details are given of a redrift treatment being used to restore the compensation in the intrinsic region of the p–i–n detectors. The redrifted detectors were used for about 10 days with 10 to 12 MeV protons before radiation damage effects reappeared. A second 24 hr redrift again restored them to their original state. (Australia)

25618 (JINR–P13-6219) RC PULSE SHAPER FROM THE SEMICONDUCTOR RADIATION DETECTORS WITH THREE-FOLD DIFFERENTIATION. Ormandzhiev, S. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

A system with three differentiating and n integrating RC circuits for pulse shaping from semiconductor detectors is investigated. The formulae for the pulse parameters, signal-to-noise ratio, and resolution time are obtained. The parameters of the schemes are compared with the single-, two- and three-fold differentiation. The calculation results are listed in tables and graphs. (auth)

25619 (JINR–P13-6247) TECHNIQUE FOR MANUFACTURING SPECTROMETRIC ΔE-DETECTORS. Zorin, G. N.; Kushniruk, V. F.; Kharitonov, Yu. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

A technique is described for manufacturing silicon surface-barrier ΔE detectors that are 15 to 140 μm thick with the plane-parallelity not less than 0.5 μm on the diameter of 20 to 28 mm having a working area of 0.2 to 1.5 cm^2. (auth)

25620 (NP–19211) EFFECT OF ETCHING INTERRUPTIONS ON TRACKS FORMATION IN PLASTICS. Note No. 321. Baroni, G.; Di Liberto, S.; Romano, G.; Sgarbi, C.; Tabasso, M. C. (Rome Univ. (Italy). Istituto di Fisica. Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 5 Jun 1971. 24p. Dep. NTIS (U. S. Sales Only).

The effect of etch interruptions on track formation was studied in nitrocellulose plastic sheets by using α-particle tracks. The "step effect" is remarkable on some parameters of the tracks; while on others, as the lengthening with development time (that is the most useful in identification of high ionizing tracks), it seems to be absent. An attempt is made to interpret this effect on the basis of the known dissolution properties of polymers. (5 figures, 3 tables) (auth)

25621 (RDT-C–10-3-T(3-72)) MULTIPLE INPUT PREAMPLIFIER/DISCRIMINATOR FOR USE WITH NEUTRON COUNTERS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Mar 1972. 18p. RSO.

Performance standards and testing procedures for multiple input preamplifier/discriminator for combining the signals of up to three neutron counting tubes are presented. (W.H.K.)

25622 (RT/FI–(71)32) STOCHASTIC METHODS FOR MEASURING DEAD-TIME LOSSES. Iozzino, A.; Pacilio, N. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 18 Oct 1971. 51p. Dep. NTIS (U. S. Sales Only).

Dead time is responsible for losses of events occurred in a detection and counting apparatus when either of them is already busy. This way the instrumentation introduces a negative correlation in the pulse sequence under analysis, because dead time intervals are not randomly distributed but are generated by the pulses themselves. A probabilistic approach to the above-mentioned phenomena leads to the development of stochastic methods for measuring counting losses and obtaining correct final data. The counting of steady-state random-emitting sources is assumed. Paralyzable and nonparalyzable counters are separately treated, when this is possible. An extensive set of experimental data is given in order to support the theoretical statements and check their validity. (auth)

25623 (UCRL–73493) TIME-RESOLVED X-RAY DETECTION USING MOS-C DETECTORS. Kalibjian, R.; Ciarlo, D.; Mayeda, K.; Boster, T. (California Univ., Livermore. Lawrence Livermore Lab.). 16 Feb 1972. 7p. (CONF-720306–2). Dep. NTIS.

From Scintillation and semiconductor counter symposium; Washington, D. C. (1 Mar 1972).

To develop a fast x-ray detector with a memory, we have performed experiments with metal-oxide-semiconductor capacitor (MOS-C) devices. For time-resolved recording of the x-ray pulse, a linear array of detectors is uniformly irradiated while the elements are sequentially biased at Δt time intervals; significant positive charge trapping occurs in each element of the array only during the period Δt when the high field bias is applied across the dielectric. Detection of 10-ns resolution has been recorded. Time-resolution is presently limited by the bandwidth limitation of the bias strobing method. (auth)

25624 PHASE COMPENSATED ELECTROMAGNETIC DELAY LINES FOR WIRE CHAMBER READOUT. Grove, R.; Ko, I.; Leskovar, B.; Perez-Mendez, V. (Univ. of California, Berkeley). Nucl. Instrum. Methods; 99: No. 2, 381-5(1972).

A phase-compensated distributed-parameter electromagnetic delay line suitable for the readout of the positions of ionizing tracks in multiwire proportional chambers is described. Delay lines with delays of 40 to 200 ns/cm having a rectangular cross section were designed. The rectangular cross section enables them to be capacitatively coupled to the wire chamber simply by clamping them on the wire chamber external leads. The coupling coefficients between the chamber and delay line are approximately 3 to 10%. The electronic readout accuracy is better than ±0.1 mm due to the delay line. (6 figures, 1 table) (auth)

25625 FAST PROCESS AND CODING SYSTEM FOR A SET OF MULTIWIRE PROPORTIONAL CHAMBERS. Aebischer, D.; Heer, E.; Hess, R.; Mauron, B.; Werren, D. W. (Univ., Geneva). Nucl. Instrum. Methods; 99: No. 2, 405-11(1972).

The complexity of information obtained with a set of multiwire proportional chambers (typically 1000 wires) can drastically be reduced by adequate coding. The described system, a modular set-up using MECL II integrated circuits, is designed to recognize different firing configurations and leads to the geometrical coordinates of the particle tracks. (8 figures, 2 tables) (auth)

25626 GAS DISCHARGE MECHANISM AND PROPERTIES OF HALOGEN-QUENCHED COUNTERS. Srdoc, D. (Inst. Rudjer Boskovic, Zagreb). Nucl. Instrum. Methods; 99: No. 2, 321-32(1972).

The discharge mechanism in halogen counters was investigated experimentally. Uv photons emitted by bromine and neon resonance photons were found responsible for the discharge propagation. Some peculiar properties of halogen counters, such as the dependence of the starting voltage on the counter parameters, the delay of the pulse build-up, the threshold oscillations and the

counter dead time, were interpreted on the basis of the discharge mechanism. (10 figures) (auth)

25627 PULSE HEIGHT RESPONSE CHARACTERISTICS FOR HEAVY IONS IN SILICON SURFACE-BARRIER DETECTORS. Steinberg, E. P. (Argonne National Lab., Ill.); Kaufman, S. B.; Wilkins, B. D.; Gross, C. E.; Fluss, M. J. Nucl. Instrum. Methods; 99: No. 2, 309-20(1972).

A previous study of the pulse-height defect (PHD) for heavy ions (Ni, Cu, Ag, Au, and U) in a silicon surface-barrier detector was extended to include 10 different detectors and higher-energy ions. Iodine was also added to the list of ions studied. All of the low-resistivity, heavy-ion-type detectors showed nearly identical response characteristics. The PHD for these detectors appears to be a general phenomenon that can be described as the sum of a simple energy loss in the gold surface layer, a calculated nuclear-stopping defect, and a residual defect expressed as a linear dependence on the difference between the electronic stopping power of the ion in silicon and a constant critical value. High-resistivity detectors exhibited larger residual defects, but qualitatively similar behavior. (13 figures, 3 tables) (auth)

25628 COMPOSITE DIRECTIONAL γ-RAY SCINTILLATION DETECTOR. Petr, I.; Birks, J. B.; Adams, A. (Univ. of Manchester, Eng.). Nucl. Instrum. Methods; 99: No. 2, 285-93(1972).

A new type of γ-ray detector which has good directivity and detection efficiency without external shielding is described. The pulses from two scintillators, viewed by the same photomultiplier, are separated by pulse shape discrimination, and the difference count rate is measured. Measurements on typical detector systems are compared with the calculated characteristics. Simple methods of improving the directivity, detection efficiency, energy range, and versatility of the instrument are described. (9 figures) (auth)

25629 TIME DEGENERACY OF MULTIWIRE PROPORTIONAL CHAMBERS. Charpak, G.; Fisher, H. G.; Gruhn, C. R.; (and others) (CERN, Geneva). Nucl. Instrum. Methods; 99: No. 2, 279-84(1972).

The deterioration with time of multiwire proportional chambers using isobutane as one component of the gas mixture is studied. It is shown that, by addition of methylal among others, a long lifetime can be obtained without changing the properties of the gas mixture. Irradiation tests of $5 \times 10^{10}/cm^2$ showed no alteration in the chamber performance. (10 figures, 2 tables) (auth)

25630 PSEUDOCUMENE BASED LIQUID SCINTILLATOR. Aitkenhead, Wm.; Crouch, J. H.; Risk, W. S. (Univ. of Maryland, College Park). Nucl. Instrum. Methods; 99: No. 2, 273-7(1972).

Properties of a liquid scintillator using pseudocumene as a solvent are described. The scintillator has a much higher light output than mineral oil-based liquid scintillators and is very inexpensive when the user mixes it himself. The scintillator can be used in acrylic plastic containers and is not much more volatile than mineral oil, but some care must be used in handling it. This report covers studies carried out through July 31, 1971. (2 figures, 2 tables) (auth)

25631 SINGLE CRYSTAL NaI(Tl) POLARIMETERS. Ljubicic, A.; Logan, B. A. (Univ. of Ottawa. Carleton Univ., Ottawa). Nucl. Instrum. Methods; 99: No. 2, 269-72(1972).

The polarization sensitivities of a $\frac{1}{8}'' \times 1''$ diameter NaI(Tl) crystal and a $\frac{1}{4}'' \times 1''$ diameter NaI(Tl) crystal were investigated. The polarization sensitivities are high enough for the detectors to be suitable for detecting the plane of polarization of linearly polarized photons over a wide energy range. The merits of the single detectors compared with conventional polarimeters are discussed. (2 figures, 1 table) (auth)

25632 COMPACT NEUTRON DETECTOR USING RESONANT SCATTERING FROM LITHIUM TO IDENTIFY LEVELS FOLLOWING NEUTRON PRODUCING REACTIONS. Bell, R. A. I.; Thompson, J. V.; Graham, I. G.; Davidson, W. F. (Australian National Univ., Canberra). Nucl. Instrum. Methods; 99: No. 2, 217-19 (1972).

This instrument utilizes the sole sharp (Γ = 32 keV) neutron scattering resonance of ^7Li at 258 keV. Neutrons from a reaction are collimated on to a target of lithium metal. The scattered and transmitted fluxes are detected in highly efficient ^3He proportional counters surrounded by heavily shielded paraffin moderators. The ratio of these fluxes peaks sharply whenever the energy of a neutron group is on resonance, so that the excitation function of the ratio displays peaks corresponding to levels of the final nucleus. The present instrument is somewhat smaller and more mobile than previously described versions. (2 figures) (auth)

25633 STUDY OF THE DETECTION EFFICIENCY OF A ^{10}B DETECTOR FOR NEUTRON-CAPTURE GAMMA RAYS BY THE MONTE CARLO METHOD. Bayer, R. (Inst. of Nuclear Research, Rez, Czech.). Nucl. Instrum. Methods; 99: No. 2, 339-43(1972). (In French).

For measurements of neutron spectra by the time-of-flight method, calculations and analysis of the detection efficiency for the capture of gamma rays in a system consisting of a central detector surrounded by four NaI(Tl) crystals were carried out. The central detector of cylindrical shape contains a homogeneous mixture of ^{10}B with polyethylene of different thickness and/or a 1.5 cm thick layer of boric carbide. The gamma-ray detection probabilities as functions of the position of neutron capture are calculated by the Monte Carlo method. (7 figures, 2 tables) (auth)

25634 MAKING OF GRIDS ON PLASTIC DETECTORS. Birabeau, J. P.; Cordaillat, A.; Mendola, O. (CERN, Geneva). Nucl. Instrum. Methods; 99: No. 2, 355-7(1972). (In French).

In order to facilitate the locating of tracks of charged particles in cellulose nitrate and polycarbonate (Makrofol, Lexan) foils, a method was developed for the photodeposition of translucent coordinate grids on these materials. The grids are resistant to the strongly caustic solutions used in developing tracks in plastic foils. (2 figures) (auth)

25635 LIGHT COLLECTION IN A LONG CYLINDRICAL NE 110 PLASTIC SCINTILLATOR. Baers, B.; Markkanen, E. (Helsinke Univ. of Tech., Otaniemi, Finland). Nucl. Instrum. Methods; 99: No. 2, 419-20(1972).

The smoothing of the light collection from different regions of a long cylindrical plastic scintillator is demonstrated when the light is collected at one end of the rod. A specific feature of the present work is the use of a diffusion reflector in nonoptical contact with the rod. (1 figure) (auth)

25636 DEVELOPMENT OF A HIGH SENSITIVITY LIQUID SCINTILLATION–NaI(Tl) COINCIDENCE DETECTOR FOR X–γ EMITTERS IN LUNAR ROCKS. Fruchter, J. S. (Univ. of California, San Diego, La Jolla). Nucl. Instrum. Methods; 99: No. 2, 349-54(1972).

A new type of high-sensitivity counter employing a liquid scintillation cell as a coincidence gate for a 3" NaI(Tl) well crystal was developed for the detection of small amounts of x–γ emitting nuclides. This counter has approximately 10 times the efficiency of a comparable detector employing a conventional gas proportional counter as the coincidence gate. The background of the existing system under the full width at half maximum of the ^{54}Mn photopeak is 0.02 cpm. Measurements to the 15% precision level of as little as 0.25 dpm of ^{54}Mn in lunar rock samples are reported. The applicability of the counter to x–γ emitters other than ^{54}Mn is discussed. (6 figures, 3 tables) (auth)

25637 MONITORING OF THE WHOLE DYNAMIC RANGE OF A REACTOR WITH A SINGLE BORON CHAMBER FUNCTIONING UNDER CURRENT COLLECTION IN NONPROPORTIONAL REGION. Mantakas, Ch.; Polychronakis, G. (Democritus Nuclear Research Center, Athens). Nucl. Instrum. Methods; 99: No. 2, 301-8(1972). (In French).

A boron neutron detector system was developed capable of monitoring the whole dynamic range of a reactor. This was achieved with a boron-lined chamber working under current collection and no multiplication (M = 1) conditions, and very low noise electronics. An electronic system which presents a bandwidth of 3 MHz, input impedance of 100 Ω, and 0.7 μV rms noise referred to the input (under real conditions in the reactor) is described. A new method for obtaining the low noise required is also described. (10 figures) (auth)

25638 SELF-TRIGGERING STREAMER CHAMBER AND ITS APPLICATIONS TO NUCLEAR PHYSICS. Kobayashi, Shigeharu (Kyoto Univ.). Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys., Geophys., Chem.; 33: No. 3, 325-37(Mar 1971).

Some studies have been made on the self-triggering streamer chamber which is a new promising particle detector suitable for low energy nuclear physics. For this purpose, the self-triggering spark chamber and the streamer chamber have also been studied. A method of detecting gas scintillation from neon has been investigated and the gas mixture consisting of neon (99.5%) + nitrogen (0.5%) has been found to be suitable for the self-triggering operation of the streamer chamber. Successful operation of the self-triggering streamer chamber has been demonstrated by using a weak polonium α source. (auth) (Japan)

25639 KINETICS OF PHASE DECOMPOSITION AND ITS APPLICATION TO NUCLEAR PARTICLE DETECTION. Mahoney, Richard Warner. Washington, D. C.; Catholic Univ. of America (1971). 166p. University Microfilms Order No. 72-5746. Thesis.

It was shown that the dramatic change in isothermal viscosity in a sodium borosilicate glass below the coexistence temperature

can be explained on the basis of growth of the average microstructure size, $\bar{r}$. The environmental relaxation model of Macedo and Simmons best predicted the observed viscosity behavior when a value of 100 Å was used for the radius of the environment affecting a particular molecule. Comparison of the time dependence of the growth of $\bar{r}$ with that predicted by the theory of Lifshitz and Slyozov and of Wagner indicated that in the range 200 Å $\lesssim \bar{r} \lesssim$ 1000 Å, the growth of $\bar{r}$ is through diffusion-controlled ripening. Comparison of the activation energy for growth from the size measurements (97 ± 6 kcal/mole) with that for diffusion from the time shifts of the viscosity isotherms (103 kcal/mole) led to the conclusion that this activation energy corresponds to interdiffusion of SiO_2 through the silicate-poor matrix. The glass has an interconnected structure, and the viscosity measurements are essentially a measurement of the viscosity of the viscous phase. The average activation energy for interdiffusion for the viscous phase, computed from the viscosity shifts of the viscosity isotherms, was 137 kcal/mole, almost the value for self-diffusion in pure SiO_2 (140 kcal/mole). Thus it is concluded that this activation energy refers to diffusion of SiO_2 in the silicate-rich phase. An attempt was made to verify the proposition that phase decomposition preferentially takes place around radiation damage sites in glass. Thus heat treatment can be used to enhance radiation damage sites, making them large enough for electron microscope observation. A sodium silicate glass was used with two sources. Structure attributed to radiation appeared only on the irradiated surface of a glass sample after heat treatment. No such structure appeared regardless of thermal history if the glass was not irradiated. The similarity of radiation damage structure from ^{252}Cf (which emits heavy fission fragments and alpha particles) and from ^{241}Am (which emits only alpha particles) led to the conclusion that alpha particles were being detected. (Diss. Abstr. Int., B)

25640 THRESHOLD DETECTORS IN THE MEASUREMENT OF NEUTRON SPECTRA. Koshaeva, K. K.; Kraitor, S. N.; Pikel'ner, L. B. At. Energ. (USSR); 32: No. 1, 68-70(Jan 1972). (In Russian).

The characteristics of a bank of threshold detectors designed for studying neutron spectra were examined. The detectors consisted of ^{235}U, $^{235}U-Cd$, ^{237}Np, ^{238}U, and ^{32}S. Data were obtained on calculated and experimental spectra of several critical assemblies and reactors. The effective fission cross section of ^{238}U was measured, and differential neutron spectra were evaluated between 0.04 and 0.56 MeV. Neutron spectra in a pulsed reactor were obtained using 4 cm of water as a moderator. The maximum error involved in neutron flux determinations is tabulated for various regions of the energy spectrum and for different spectra. (3 figures, 1 table) (K.S.W.)

25641 DETERMINATION OF THE ION-INDUCED ELECTRON YIELD FROM A STATISTICAL TREATMENT OF PULSE-HEIGHT DISTRIBUTION CURVES MEASURED WITH AN ION-ELECTRON-SCINTILLATION DETECTOR. Werner, H. W.; Berg, J. v. d. (Philips Research Labs., Eindhoven, Netherlands). J. Appl. Phys.; 43: No. 4, 1524-9(Apr 1972).

A statistical analysis of pulse-height distribution curves at the output stage of an ion-electron-scintillation detector has been carried out. It is shown that the average ion-induced yield $\bar{\gamma}$ of electrons at the converter can be determined from statistical quantities of the pulse-height distribution curves. Corrections are included for nonuniformity in yield in the different stages and for the fact that particles releasing no secondaries are not counted. The energy dependence, mass dependence, and the isotopy effect for the $\bar{\gamma}$ values determined according to this method are in good agreement with values found in using other methods. (auth)

25642 DETECTION EFFICIENCY OF ELECTRON MULTIPLIERS FOR LOW-ENERGY ELECTRONS. Bunting, W. D. Jr.; Tarstrup, J.; Heikkila, W. J. (Univ. of Texas, Dallas). J. Appl. Phys.; 43: No. 4, 1585-90(Apr 1972).

Pulse-height spectra have been obtained for electron multipliers with discrete dynodes of CuBe. A peak in the spectrum shows up at low pulse heights (≈0.1 pC for a multiplier with a dc gain of about 10^6), but a long tail extends out to very large pulses. These observations can be understood in terms of secondary emission processes. They have provided a good basis for the design and calibration of a soft particle spectrometer for the ISIS-2 satellite. The detection efficiency for 300-eV electrons, with a 14-stage venetian blind multiplier having a total gain of 10^6, is about 80%. Below 100 eV, the detection efficiency falls off, but in practice this can be overcome by postacceleration. At higher energies, it also decreases to about 30% at 4 keV. This efficiency is reduced at very high counting rates, above 10^7 sec^{-1}, owing partly to amplifier bandwidth limitations related to noise immunity requirements, and partly to the finite rise time of the multiplier pulses. (auth)

25643 OPERATIONAL CHARACTERISTICS OF AIR-EQUIVALENT SCINTILLATION DETECTORS. Volosyuk, G. P.; Vershinina, S. P.; Gunder, O. A.; Prokof'eva, L. S.; Sigalova, L. V. At. Energ. (USSR); 32: No. 2, 171-2(Feb 1972). (In Russian).

The effects of radiation and thermal interaction on the dosimetric characteristics of plastic and ZnS(Ag) scintillation detectors are described. Samples were given 6,000 R/sec ^{60}Co irradiation, with a resultant decrease in light output of the ZnS(Ag). Similarly, heating or cooling the detectors (−60 or +60°C) also led to a diminution of light output. (3 figures) (K.S.W.)

Radiation Dosimeters

Refer also to abstract 25801.

25644 (AERE-M-2481) INVESTIGATION INTO THE POTENTIAL OF POLYCARBONATE AND OTHER FILMS AS MEGARAD DOSEMETERS. Douglas, J. A.; Gibson, J. A. B.; Marshall, M.; Taylor, W. M. (Atomic Energy Research Establishment, Harwell (England)). Feb 1972. 7p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

A dosemeter was required to cover the range 10 to 100 Mrad. The effect of ^{60}Co γ-rays on the U.V. absorbance of various thicknesses of polycarbonate, Melinex and polypropylene film was examined. Melinex and polypropylene were rejected because of fading and dose rate dependence. 210 μm thick polycarbonate can measure doses in the range 3 to 50 Mrad with a precision of ±1% and can detect doses down to 0.1 Mrad. The reading is stable after 10 hours' storage and shows only a small (10%) dose rate dependence from 5 to 510 krad h^{-1}. The dose range can be extended to at least 160 Mrad by using a thin (1.7 μm) polycarbonate sheet. (auth) (UK)

25645 (CLOR-85/D) EXAMINATION OF ACCIDENTAL THERMOLUMINESCENT DOSIMETER IN ROUTINE DOSIMETRIC USES. Wolska-Witer, M.; Koczynski, A.; Musialowicz, T.; Jakubiak, J. (Centralne Laboratorium Ochrony Radiologicznej, Warsaw (Poland)). 1971. 28p. (In Polish). Dep. NTIS (U. S. Sales Only).

A thermoluminescent accidental dosimeter (ADT) with CaF_2:Mn powder for X and gamma radiation has been examined during two years for various dosimetric purposes. Small doses have been determined by the glow curve method. Exposures from 10 mR to 1000 R have been measured. The errors of the measurements and the possibility of a decrease in the applications of ADT for individual dosimetry purposes are discussed. (auth)

25646 (CLOR-86/D) SEMIAUTOMATIC MACHINE FOR DEVELOPING OF PERSONAL MONITORING AND OTHER X-RAY FILMS. Smoniewski, J. (Centralne Laboratorium Ochrony Radiologicznej, Warsaw (Poland)). 1971. 21p. (In Polish). Dep. NTIS (U. S. Sales Only).

The semi-automatic developing machine designed and built for uniform processing to develop personal monitoring and other X-ray films is described. The temperature of developer is stabilized with accuracy ± 0,1°C. The developer and fixer velocity are uniformed in the whole volume. The developer and stop-bath are automatically mixed by gas. The replenishment system can be joined to the tanks. The good washing of films is guaranteed by water running against the films. (auth)

25647 (DP-1288) BETA-GAMMA MONITORING OF PERSONNEL WITH THERMOLUMINESCENT DOSIMETERS. Hoy, J. E.; Boiter, H. P.; Hall, R. M. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Feb 1972. Contract AT(07-2)-1. 20p. Dep. NTIS.

A thermoluminescent dosimeter using two ^7LiF chips was developed to monitor penetrating and nonpenetrating components of personnel radiation exposures. Thermoluminescent dosimeters are more accurate, are less energy dependent, have a wider range of sensitivity, and are simpler to use than film dosimeters. The present thermoluminescent dosimeter system at Savannah River is manually operated, but it can be automated. (auth)

25648 (KFKI-71-82) NUCLEAR ACCIDENT DOSIMETRY MEASUREMENTS AT THE 2nd I.A.E.A. INTERCOMPARISON AT OAK RIDGE, USA, MAY 1971. Makra, S.; Zarand, P. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Oct 1971. 11p. Dep. NTIS (U. S. Sales Only).

Results of the intercomparison of nuclear accident dosimetry systems, using the HPRR as the radiation source, are presented. Details are presented for the calibration of the dosimetry system used at the Central Research Institute for Physics at Budapest which consists of phosphorus and sulfur pellets, bare and cadmium-covered gold foils, Kodak personnel monitoring film, and a thermoluminescent glass. (W.H.K.)

25649 (ORNL-TM-3668) FURTHER STUDIES ON TSEE ACTIVATORS IN BeO. Moreno y Moreno, A.; Cheka, J. S.; Nagpal, J. S.; Gammage, R. B.; Becker, K. (Oak Ridge National Lab., Tenn.). Mar 1972. Contract W-7405-eng-26. 26p. Dep. NTIS.

In a continuing effort to study, understand, and improve the dosimetric characteristics of TSEE detectors based on ceramic BeO, a variety of potential activators have been incorporated and their influence on the exoelectron emission examined. In some cases, compounds of such elements as Li, B, and Mn were diffused into the surface during a second firing. In other commercially obtained BeO ceramics, metal oxides such as MgO, CaO, Al_2O_3 had already been added homogeneously in varying amounts prior to the original fabrication of the ceramics. BeO ceramics with an increased SiO_2 content have been prepared, and the properties compared to those of natural Be compounds (phenacite). A modified readout procedure has also been investigated. The results are briefly described and discussed. (auth)

25650 INTERCOMPARISON OF HIGH-DOSE DOSIMETERS IN ACCELERATOR RADIATION FIELDS. Routti, J. T.; van de Voorde, M. H. (CERN, Geneva). Nucl. Instrum. Methods; 99: No. 3, 563-71(1972).

The radiation fields and dose rates produced by high-energy proton beams directed on thick internal targets were studied at the CERN 28 GeV/c Proton Synchrotron. Description and intercomparison of the readings of 17 high-dose dosimeter systems are given. (4 figures, 2 tables) (auth)

Nuclear Spectroscopic Instrumentation

25651 (AE-444) Ge(Li) BORE HOLE PROBE FOR IN SITU GAMMA RAY SPECTROMETRY. Lauber, A.; Landstroem, O. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Jan 1972. 27p. Dep. NTIS (U. S. Sales Only).

The construction and properties of a Ge(Li) bore hole probe for in situ gamma ray spectrometry are described. The probe has the form of a cylinder 8.9 cm in diameter and 160 cm long. It contains a 22 cm^3 coaxial Ge(Li) detector. Cooling is by liquid nitrogen. Holding time of the assembled probe is in excess of ten hours; energy resolution is 2.3 keV for 122 keV photons and 2.6 keV for 1333 keV photons. The probe has been used in field experiments in the Ranstad uranium mine and for the study of neutron activation spectra obtained in bore hole models. Results from these experiments are presented and discussed. The Ge(Li) probe gives promise to become a powerful tool in bore hole activation analysis. (auth) (Sweden)

25652 (ANCR-1043) GAUSS V: A COMPUTER PROGRAM FOR THE ANALYSIS OF GAMMA-RAY SPECTRA FROM Ge(Li) SPECTROMETERS. Helmer, R. G.; Putnam, M. H. (Aerojet Nuclear Co., Idaho Falls, Idaho). Jan 1972. Contract AT(10-1)-1375. 68p. Dep. NTIS.

A description is presented of the computer program GAUSS V, which was written to carry out the analysis of gamma-ray spectra from Ge(Li) spectrometers. This program includes routines to carry out a nonlinear least-squares fit of a Gaussian function to a peak and to compute gamma-ray intensities and energies. In the latter calculation, a correction for the nonlinearity of the system is included. The peaks in the spectrum to be analyzed can be identified either manually by the user or automatically by a peak-location routine. Complete descriptions of the experimental and input options are given as well as the card formats. (17 figures, 6 tables) (auth)

25653 (BARC-558) DOUBLE FOCUSING MAGNETIC BETA-RAY SPECTROMETER USING CONICAL POLE FACES. Sahoo, H. K.; Misra, S. C.; Gupta, U. C. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 17p. Dep. NTIS (U. S. Sales Only).

The theory and fabrication of a double focusing magnetic spectrometer of $\pi\sqrt{2}$ type are described. The double focusing field has been obtained using conical pole faces of iron. The field distribution in and around the pole gap has been measured and the data have been used to improve the linearity and the transmission of the spectrometer by further shaping the pole faces. The spectrometer has a radius of 12.7 cm and a momentum resolution (F.W.H.M.) of 0.5% at a transmission of 0.15%. The energy range is from 100 keV to 2.4 MeV which covers the beta rays and the conversion electrons emitted by most of the commonly used radioisotopes. (auth)

25654 (CEA-R-4290) APPLICATION OF THE GRADIENT METHOD TO A STUDY OF THE SIGNAL/NOISE RATIO OUTPUT OF FILTERS USED IN γ RAY SPECTROMETRY WITH SEMICONDUCTORS. Chazal, Guy; Hoclet, Odette; Kermorgant, Joseph; Ringeard, Claude; Voiculescu, Georges (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan 1972. 95p. (In French). Dep. NTIS (U.S. Sales Only).

The gradient method was applied to the investigation of the noise/signal ratio at the output of two types of filters used in gamma-spectrometry with a semiconductor detector. This enables a program to be written, in FORTRAN IV, for calculation of the minimum of a function involving 1 to 10 minimization parameters. There is provision for two methods of determining definite integrals in order to permit calculation of the minimum of a function involving a number of integrals. (auth)

25655 (ORNL-TM-3669) HIGH RESOLUTION SPECTROMETER SYSTEM WITH PARTICLE IDENTIFICATION FOR 1- THROUGH 60-MeV HYDROGEN AND HELIUM PARTICLES. Bertrand, F. E.; Burrus, W. R.; Hill, N. W.; Love, T. A.; Peelle, R. W. (Oak Ridge National Lab., Tenn.). Jan 1972. 51p. Dep. NTIS.

A coincidence semiconductor spectrometer system based on a Ge(Li) total absorption detector was applied to the simultaneous spectroscopy of all charge-1 and -2 particles from targets bombarded with protons with energy up to 62 MeV. Output spectra cover the range from the full energy down to a 1- to 5-MeV threshold, which depends on particle type. The method for choosing the thicknesses for the two ΔE detectors is discussed, and unusual features of the system are described. Particles too slow to penetrate the first ΔE counter were sorted according to mass by using the flight-time vs E discrimination, while the more energetic particles were separated using two sets of $\Delta E \times E$ discrimination. Germanium detectors thick enough to stop 60-MeV protons were used with particles entering perpendicular or parallel to the field lines, and in either case the only significant inactive region in the path of the detected particles was the protective foil over the Ge(Li) detector. The typical pulse-height resolution of the system was about 200 keV for 60-MeV protons, although a germanium detector used alone gave 55 keV resolution at this energy. Analysis was performed after the experiments by using magnetic tapes written by an on-line computer; corrections to the pulse-height spectra for reaction and collimator tails are discussed. The electronic logic system is described, including portions for event characterization, for use on an "active" detector collimator, and for pileup pulse rejection based on timing information. (12 figures, 2 tables) (auth)

25656 (UARAEE-121) 50 cm IRON-FREE DOUBLE FOCUSING ELECTRON SPECTROMETER AT THE ATOMIC ENERGY ESTABLISHMENT, U.A.R. Nilsson, O.; Migahed, M.; Mostafa, M. A.; El-Farrash, A. H.; Abdel-Hamid, M. G.; Abdel-Hallem, A. (Atomic Energy Establishment, Cairo (Egypt). Nuclear Physics Dept.). 1971. 15p. Dep. NTIS (U. S. Sales Only).

A reconstruction of the iron-free double focusing electron spectrometer is described. Installations of new and precise equipment in the current regulating and measuring system are described. Recordings of the isoaberration contours were performed and then four fixed baffles were shaped corresponding to different resolutions. The internal conversion L-spectrum of the 99 keV and 100 keV transitions in ^{183}W and ^{182}W was taken as an example of the recorded spectra. A resolution of ~0.07% was recorded using the smallest baffle and a thin source. (auth)

25657 (UCRL-Trans-10593) STABILIZED BOREHOLE GAMMA SPECTROMETER. Bragin, A. A.; Korenev, D. P.; Blyumentsev, A. M.; Feld'man, I. I.; Zheltikov, A. N.; Korotkova, V. A. Translated for Univ. of California, Lawrence Livermore Lab., Livermore, from Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.; No. 7, 189-97(1969). 14p. Dep. NTIS.

The spectrometer consists of a borehole instrument with two replaceable detectors based on photomultipliers FEU-13 and FEU-35, a measuring panel, and a supply unit. The detector consists of a 40 × 50 mm NaI(Tl) scintillation counter. Automatic gain control of the measuring circuit with respect to a light reference signal is used to stabilize the spectrometer. The apparatus is intended to work at temperatures of 0 to 50°C with any type of standard logging cable up to 3 km long. A block diagram of the system is presented, and calibration and test results are briefly discussed. (W.H.K.)

25658 LONG-LIVED STANDARDS FOR THE EFFICIENCY CALIBRATION OF Ge(Li) DETECTORS. Ahmad, I.; Wahlgren, M. (Argonne National Lab., Ill.). Nucl. Instrum. Methods; 99: No. 2, 333-7(1972).

The intensities of the γ rays and K x rays associated with the decay of ^{249}Cf, ^{243}Am, ^{239}Np, and ^{243}Cm were measured with respect to IAEA standards. Because of their long half-lives and ease of standardization by accurate alpha counting, these nuclides are recommended as standards for absolute efficiency calibration of Ge(Li) detectors. (4 figures, 3 tables) (auth)

25659 NEUTRON SPECTROMETRY WITH PROTON-RECOIL PROPORTIONAL COUNTERS IN THE ENERGY REGION UP TO 10 MeV. Werle, H. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instrum. Methods; 99: No. 2, 295-300(1972).

Large cylindrical proportional counters were used in parallel neutron beams for spectrum measurements in the energy region up to 10 MeV. Measurements with monoenergetic neutrons and a series of comparisons with other techniques showed that results with similar accuracies as are claimed in the low-energy region (<2 MeV) can be obtained. Problems specially related to the high-energy region are discussed. (7 figures, 2 tables) (auth)

25660 BACKGROUND SUBTRACTION PROBLEM CONNECTED WITH Ge–Li DETECTOR GAMMA SHAPES. Pratt, T. A. E. C. (Illinois State Univ., Normal). Nucl. Instrum. Methods; 99: No. 2, 205-16(1972).

A detailed study of the effect of the background subtraction process in the analytic fit of a gamma spectrum of a Ge(Li) detector is undertaken. (20 figures, 12 tables) (auth)

25661 FAST-TIMING CHARACTERISTICS OF SOME CHANNEL ELECTRON MULTIPLIERS. Green, M. I.; Kenealy, P. F.; Beard, G. B. (Wayne State Univ., Detroit). Nucl. Instrum. Methods; 99: No. 3, 445-51(1972).

The pulse shapes and fast-timing characteristics of two types of Bendix channel electron multipliers were studied. A relationship between pulse widths (in the saturation mode of operation) and the dispersion in transit times of the secondary electrons across the multipliers is also shown by using this knowledge, a method was devised which reduced the fwhm of the prompt time resolution curve by approximately a factor of 2. Application of these techniques in the measurement of short lifetimes using a delayed coincidence system is illustrated in lifetime measurements of levels in ^{59}Co and ^{170}Yb. (9 figures, 1 table) (auth)

25662 NEUTRON-INSENSITIVE γ-RAY DETECTOR. Ewen, K.; Gonsior, B. (Univ., Cologne. Ruhr Univ., Bochum, Ger.). Nucl. Instrum. Methods; 99: No. 3, 573-8(1972). (In German).

A liquid scintillation detector is described which contains C_6F_6 as a solvent. This detector has a relatively high γ-ray efficiency and a very low neutron efficiency. The detector is compared with a NaI detector of the same size. Above a discrimination level of 0.5 MeV the γ-ray efficiency of the liquid scintillation detector amounts to 25% of that of the NaI detector, whereas the neutron efficiency of the NaI detector is at least 250 times as high as that of the liquid scintillation detector. (7 figures) (auth)

25663 TRAPEZOIDAL FILTERING OF SIGNALS FROM LARGE GERMANIUM DETECTORS AT HIGH RATES. Radeka, V. (Brookhaven National Lab., Upton, N. Y.). Nucl. Instrum. Methods; 99: No. 3, 525-39(1972).

A filter with a trapezoidal weighting function is the optimum one when both noise and variations in the charge collection time are present. A trapezoidal filter was realized by a time-variant (gated filter) system. The results obtained with large germanium detectors at high rates and higher energies are presented, and it is shown that trapezoidal filtering is essential for good resolution in this case. (15 figures, 1 table) (auth)

25664 REDUCTION OF ALPHA RAY BACKGROUND IN A CYLINDRICAL GRIDDED IONIZATION CHAMBER BY THE CATHODE PULSE METHOD. Kikuchi, J. (Waseda Univ., Tokyo); Doke, T. Nucl. Instrum. Methods; 99: No. 3, 469-75(1972).

A cylindrical gridded ionization chamber with a source area of 5000 cm^2 was constructed as a low-background alpha-ray spectrometer. Cathode pulses in the chamber were used in an attempt to eliminate the background counts caused by alpha-particles emitted from electrodes other than the cathode (source) surface. The operation condition for reduction of the background counts in this method is shown analytically. Under the condition, very low background of 0.17 counts per hour over spectral line width of 45 keV (fwhm) at 5 MeV is achieved for Mylar sheet backing. Spectra of weak alpha activities measured by this chamber are also shown. (14 figures, 1 table) (auth)

25665 FAST TIMING FROM A FISSION IONIZATION CHAMBER. Roesler, H.; Millard, J. K.; Hill, N. W. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods; 99: No. 3, 477-86 (1972).

The timing resolution of a ^{252}Cf-loaded fission ionization chamber connected to a new current preamplifier was tested by looking at coincident fission fragment pulses and pulses from fission γ rays, which are detected in a plastic scintillator. A time resolution of 1 ns fwhm could be achieved. (9 figures, 1 table) (auth)

25666 PULSE-HEIGHT ANALYSIS IN SCINTILLATION COUNTING. Laney, Barton H. (to Nuclear-Chicago Corp.). U. S. Patent 3,626,187. 7 Dec 1971. Filed 21 Jan 1969.

Coincident output pulses of a plurality of photomultipliers are selected for counting on the basis of relative amplitude as well as sum. Improvement in background and isotope resolution is obtained in liquid scintillation counting. Pulse-height analysis circuits incorporating the improvement are described. (21 figures) (auth)

High Energy Physics Instrumentation

25667 (DESY–72/2) SIMPLE METHOD FOR MEASUREMENT AND REGULATION OF THE MEMORY TIME IN STREAMER CHAMBERS. Eckardt, V.; Gebauer, H.-J. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Feb 1972. 13p. Dep. NTIS (U. S. Sales Only).

The time resolution and memory time of streamer or spark chambers is determined by the lifetime of free electrons produced by an ionizing particle. It can be varied over a large range by an admixture of electronegative gases, e.g., 10^{-5}% sulfur hexafluoride (SF_6). A simple method which allows one to measure and regulate the memory time is described. The device consists of a small ionization chamber and an electronic circuit which has been tested for the 1 m DESY streamer chamber. It has been found that, for example, a memory time of 2 μs could be controlled to within 5% accuracy. (auth)

25668 (FRNC-TH-167) HIGH ENERGY NEUTRON DETECTOR. Minard, M. N. (Paris Univ., Orsay (France)). 1971. 82p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

A high-energy (approximately GeV) neutron detector was developed in conjunction with a proposal to measure the energy dependence of N* isobar excitation in proton–proton collisions of the ISR (Intersecting Storage Rings). The specifications required (spatial resolution, temporal resolution, efficiency, and n–γ differentiation) are defined. A systematic study of the proportional chambers involved is presented. The results of tests carried out with these detectors on neutral and charged beams are set forth and explained. (France)

25669 (JINR–P13-6191) SPARK SPECTROMETERS FOR GAMMA-QUANTA AND ELECTRONS. Strugal'skii, Z. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

The possible application of multiplate spark chambers for determination of E_0 energy of registered gamma-quanta and electrons is analyzed. The methods are suggested for measuring E_0 in such chambers. The limits of the achieved accuracies for $\Delta E_0/E_0$ are presented. (auth)

25670 (JINR–P13-6222) SCINTILLATION DETECTOR FOR THE COORDINATE AND TIME-OF-FLIGHT MEASUREMENTS. Bunyatov, S. A.; Zalikhanov, B. Zh.; Khalbaev, A.; Shtaudenmaier, H. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

The accuracies of the coordinate and time-of-flight determination in the scintillation counter of dimensions ($70 \times 10 \times 10$) cm^3 were measured by using the FEU-30 and XP-1020 photomultipliers. The counter consists of a polystyrene plastic scintillator viewed on both ends by photomultipliers. Measurements were performed using a π^- beam of momentum 175 MeV/c. The accuracies of the coordinate determinations for the XP-1020 and FEU-30 photomultipliers are equal to ±1.1 cm and ±1.5 cm, respectively. The accuracy of the time-of-flight determination for the FEU-30 is equal to ±0.4 ns. (auth)

25671 SIMPLE IONIZATION MEASURING DEVICE FOR BUBBLE CHAMBER PICTURES. Bairstow, R.; Brandstetter, A.; Hunt, J. H. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Instrum. Methods; 99: No. 2, 345-8(1972).

A small self-contained device for the measurement of ionization in bubble chamber pictures was developed at the Rutherford High Energy Laboratory. A description of the instrument and results of ionization measurements are presented, and the possible use of this instrument as an aid for monitoring bubble chamber exposures is discussed. (3 figures) (auth)

25672 PROPORTIONAL CHAMBER SYSTEM FOR THE SLAC 20 GeV SPECTROMETER. Bloom, E.; Cottrell, R. L. A.; Johnson, G.; (and others) (Stanford Univ., California). Nucl. Instrum. Methods; 99: No. 2, 255-68(1972).

A 400-wire proportional chamber system was used in two electron scattering experiments with the SLAC 20-GeV spectrometer. Chamber construction and associated electronics are described in detail, and the resultant performance during data taking (over a three-month period) is discussed. (15 figures, 3 tables) (auth)

25673 COSMIC RAY ISOTOPE AND CHARGE RESOLUTION USING LARGE AREA SCINTILLATION–CHERENKOV–TOTAL EN-

ERGY TELESCOPES. Webber, W. R.; Kish, J. (Univ. of New Hampshire, Durham). Nucl. Instrum. Methods; 99: No. 2, 237-50(1972).

The response to multiply charged cosmic rays of two different very-large-area counter telescopes employing dE/dx, total-energy, and Cherenkov detecting elements was studied. The resolution of such systems was determined as a function of charge, energy, and thickness of detector element and compared with theoretical predictions. Simple techniques for reducing fluctuations due to geometrical effects to $\lesssim$ the 3% level are discussed. The capabilities of such systems for resolving charges and isotopes are evaluated. It appears that an effective charge resolution of fwhm $\leq 0.07\ Z^{\frac{1}{2}}$ of a charge unit and isotopic resolution, fwhm $\lesssim$ 0.7 of a mass unit, ($Z = 6$, $\beta = 0.7$ particles) can be achieved using present techniques. (18 figures) (auth)

25674 NEUTRINO EXPERIMENTS IN GARGAMELLE. Musset, P. (Ecole Polytechnique, Paris. European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 3, 105-8(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

The properties of the Gargamelle bubble chamber, when used in neutrino physics, are reviewed. The preliminary experiments concerned, principally, the study of the gauge invariance, the σ(neutrino)/σ(anti-neutrino) ratio, the search for the intermediate boson, neutral currents, and a third lepton. The possibility of a propane experiment for studying hydrogen events and high energies, is discussed. (France)

25675 DESIGN AND PERFORMANCE OF A TeV ENERGY COSMIC RAY SPECTROMETER. LaMay, L.; Masek, G. E.; Maung, T.; (and others) (Univ. of California, San Diego, La Jolla). Nucl. Instrum. Methods; 99: No. 3, 547-56(1972).

The design, construction, and performance of a cosmic-ray magnetic spectrograph for measurements of muon spectra at sea level in the high-energy region are described. The principal features are the following: design permitting rotation to provide constant detection efficiency and momentum resolution at all zenith angles (0 to 90°), a solid iron magnet whose mean $\int$Hdl $\approx$ 40 kG-m, and the use of wire spark chambers to determine the particle trajectories to high accuracy and allow rapid analysis of the data. The apparatus has an effective solid angle-area of 2000 cm^2-sr and has a yield of about 10 events a day for $E_\mu >$ 1 TeV at $\theta = 35°$. The maximum detectable momentum is measured to be 3.5 TeV/c and, when further corrections are applied, is expected to be the order of 4.5 TeV/c. (11 figures, 5 tables) (auth)

25676 CONSTRUCTION AND PERFORMANCE OF LARGE WIRE SPARK CHAMBERS WITH MAGNETOSTRICTIVE READ-OUT. Grayer, G. (CERN, Geneva); Hyams, B.; Jones, C.; (and others). Nucl. Instrum. Methods; 99: No. 3, 579-87(1972).

The construction and performance of wire spark chambers having an active area of 3.60 × 0.90 m^2, a gap of 10 mm, and a wire spacing of 1 mm are described. Magnetostrictive readout from both planes gives two coordinate values per chamber. Chambers of this type, together with smaller ones of similar construction, were part of a magnetic spectrometer which performed reliably between May 1970 and May 1971; during this time they were pulsed approximately 10^7 times. (16 figures) (auth)

25677 CONSTRUCTION AND PERFORMANCE OF THIN-WALLED CYLINDRICAL SPARK CHAMBERS USED FOR THE ORSAY ELECTRON–POSITRON STORAGE RING. Cosme, G.; Jean-Marie, B.; Jullian, S.; Lefrancois, J. (Ecole Normale Superieure, Orsay, France). Nucl. Instrum. Methods; 99: No. 3, 599-607(1972). (In French).

The cylindrical spark chambers which have been used as detectors for the storage ring ACO at Orsay are described. Each cylindrical modulus, of 7.5 mm gap and 0.21 g/cm^2, consists of two walls of low-density foam material glued on each side to a sheet made from bonding 50 μm aluminum and 130 μm mylar foils. By studying the gas and triggering system, very good multitrack efficiency was obtained without spurious sparks. In order to observe tracks in the two orthogonal directions, the high reflectivity of the aluminum on the inner walls of the gap was used. Details on the construction and performances are given. (14 figures) (auth)

25678 NOVEL MASS-SENSITIVE IMAGE-DISSECTING CHERENKOV DETECTOR. Roberts, A. (National Accelerator Lab., Batavia, Ill.). Nucl. Instrum. Methods; 99: No. 3, 589-98(1972).

A Cherenkov detector system specifically designed to provide an independent identifying trigger signal for each of the different particles present in the NAL 150-GeV/c charged-hyperon beam is described. The detector must be used in conjunction with a magnetic channel and a quadrupole focusing lens pair (or triplet). The expected detection efficiency for particles within its 140 to 160 GeV/c momentum acceptance band is over 90% for all particles lighter than the deuteron; for antideuterons it exceeds 80%. Electrons, muons, pions, and kaons are not distinguished from each other in the present design. All other known particles up to and including the deuteron mass are distinguished from each other and from the light particles. Specific triggers are provided for $(e\mu\pi K)^-$, $\bar{p}$, Σ^-, Ξ^-, Ω^-, and antideuterons. For each of these particles, separate triggers are available for at least three momentum ranges within the acceptance band. Rejection ratios for unwanted particles are expected to exceed 10^3. (12 figures, 6 tables) (auth)

Radiometric Instruments

25679 (CEA-R-4269) TRANSLATION TRANSDUCER AND ITS APPLICATION TO PRESSURE MEASUREMENTS. Gilly, Louis; Jourdan, Paul (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Feb 1972. 37p. (In French). Dep. NTIS (U. S. Sales Only).

The apparatus described is a transducer of translation associated with metallic capsules. It uses a nuclear detector and a radioactive source of alpha radiation. In this report the precision, the linearity, and different errors are studied. Use of this device as barometer for stratospheric balloons is developed. (8 figures, 8 tables) (auth)

25680 (INSJ-132) ALPHA PARTICLE THICKNESS GAUGE. Nonaka, Itaru; Sugai, Isao (Tokyo Univ. (Japan). Inst. for Nuclear Study). 15 Nov 1971. 40p. Dep. NTIS (U. S. Sales Only).

An α-ray thickness gauge has been developed for the purpose of thickness measurements of target foils for reaction experiments. The α-ray source was of ^{241}Am of 1.03 μCi and the α-ray detector was an SSD. The residual range method was used. The source and the detector were fitted to a microscope, the source to the objective revolver and the detector to the condenser holder mechanism. This was a very convenient and useful method. A semi empirical formula for the relative mass stopping powers as a function of E_α, Z and A is derived. The corrections for the differences of the temperatures between the measurements of sample and the air are discussed. (auth)

25681 (Y-1802) MONTE CARLO MODELING AND FORTRAN SIMULATION OF A COMPTON BACKSCATTER THICKNESS GAGE. Davenport, C. M. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 29 Oct 1971. Contract W-7405-eng-26. 57p. Dep. NTIS.

The Monte Carlo technique has been used to create a mathematical model of a class of coating-thickness gages based on Compton backscatter. Disc or point sources of gamma radiation are exposed to a coated target through conical-beam geometry. First-order Compton backscatter is picked up by a disc-shaped detector with a constant-energy response and a conical-beam geometry. Response, in general, is a function of the material properties and thickness of the coating material. A FORTRAN computer program for efficient simulation of the model is presented. The more important parameters of the target and detector are variable (individually) during a run; all other parameters and material properties are inputs to the program. Output is in the form of a table and graph of detector response versus any of the variable parameters such as detector orientation and thickness of coating. Provision has been made for easy optimization of the Monte Carlo calculation for any particular problem setup. (auth)

25682 LEAK RATE DETERMINATION USING ^{85}Kr. Murgatroyd, J. L. (Univ. of Aston, Birmingham, Eng.). Nucl. Instrum. Methods; 99: No. 2, 365-72(1972).

An account is given of the ^{85}Kr test for determining leak rates of tubes evacuated to a pressure of $\approx 10^{-6}$ torr. The minimum detectable air leak rate is of the order of 10^{-12} atm cm^3 s^{-1}, the limit being set by the background radiation and by the inaccuracy of dispensing a known-activity calibration standard. A description is given of the soak procedure and of the operation and calibration of two sets of alternative counting equipment. An essential requirement for unambiguous counting is the facility for efficient removal of unwanted contamination which adheres to the exterior surface of the tube as a result of the soak. Determination of the optimum cleaning process is, of course, a matter for experiment, and must be proved for each particular application. (8 figures) (auth)

Radiation Effects on Instrument Components, Instruments, and Electronic Systems

25683 (SC-R-722617) RADIATION EFFECTS IN ELECTROLUMINESCENT DIODES. Barnes, C. E. (Sandia Labs., Albuquerque, N. Mex.). [1971]. 10p. Dep. NTIS.

Following a brief discussion of the operating characteristics of light emitting diodes (LED's), radiation effects in these devices are reviewed. Recent results on neutron damage effects in SiC LED's are also presented. Based on this review, criteria are developed for radiation insensitivity of LED's. (36 references). (auth)

25684 (SC-R-722618) NEUTRON IRRADIATION EFFECTS ON DIFFUSED GaAs LASER DIODES. Noel, B. W.; Barnes, C. E.; Southward, H. D. (Sandia Labs., Albuquerque, N. Mex.). [1971]. 9p. Dep. NTIS (U. S. Sales Only).

The effects of fast neutron damage on diffused GaAs laser diodes were studied by observing the pre- and post-irradiation current-voltage characteristics and electroluminescence (EL) spectra at several temperatures between 75°K and 300°K. The pre-irradiation diode current at high temperature is dominated by nonradiative space-charge region recombination. The principal emission band at 300°K results from band-to-acceptor recombination in the p-region. A secondary band at 1.28 eV occurs via donor-acceptor pair recombination in the depletion region. At low temperature the dominant diode current flow is by nonradiative tunneling while the principal emission band contains radiative tunneling and band-filling components. Neutron irradiation increases the constant-voltage diode current. The additional current is due to space-charge region recombination (SC) at high temperatures and both SC and tunneling at low temperatures. The room-temperature damage constant is somewhat larger than that found to epitaxial GaAs laser diodes and in silicon p^+n diodes. The constant-voltage principal emission band intensity decreases with fluence at a rate such that the resultant damage constant is about half that of the SC current damage constant. Irradiation to a fluence of 1.8×10^{15} n/cm^2 (>10 keV) has no effect on the constant-voltage secondary emission band intensity. (26 references). (auth)

25685 SHIELDING METALLIC INTERLAYER TECHNIQUE HARDENS MIS DEVICES AGAINST IONIZING RADIATION EFFECTS. Esteve, D.; Buxo, J. (CNRS, Toulouse). Thin Solid Films; 10: No. 1, 155-8(Apr 1972).

A metallic interlayer close to the metal electrode prevents the radioinduced space-charge region in the oxide layer from inducing any charge at the Si surface. An experimental MOS structure was fabricated by thermally growing 6000-Å oxide on n-type Si, depositing an Al film a few Å thick, depositing reactively ~100-Å SiO_2, and finally covering with 5000-Å Al. Irradiation by an electron beam of less than 9 keV energy resulted in a ΔV_G shift 20 times smaller than for a classical MOS structure. (D.L.C.)

Miscellaneous Instruments and Components

Refer also to abstracts 25189, 25537–25543, 26167, 26592, 26881, 27389, and 27584.

25686 (GEPP-91) DESIGN DESCRIPTION OF A COMPUTER CONTROLLED NEUTRON TUBE TESTER. Rowe, W. M. (General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.). 20 Oct 1971. Contract AT(29-2)-656. 17p. Dep. NTIS.

The test equipment (PT1533) described in this report automatically tests neutron generator tubes. These neutron generator tubes are pulsed devices which emit bursts of 14-MeV neutrons in response to certain input stimuli: ion source current and target voltage. The particular reaction of interest is the tritium–deuterium reaction ($^2H + {}^3H \rightarrow {}^4H + n +$ energy), in which ions are accelerated under the force of an electric field. The tester must provide all the inputs required by the tubes and measure the neutron outputs. The tester uses a General Electric GE-PAC 30 minicomputer for controlling test parameters and acquiring and processing test data. Experience indicates that the test significantly improves uniformity of test conditions. The usual operator errors are completely eliminated. The automatic data analysis and real-time quality decisions materially reduce the time between testing and knowledge of product acceptability. (10 figures) (auth)

25687 (JINR-P13-6223) CALCULATED RESOLUTION TIME AND TIME OF RECONSTRUCTION AFTER THE AMPLITUDE OVERLOAD OF THE RC PULSE SHAPER. Avramov, S. R.; Ormandzhiev, S. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 21p. (In Russian). Dep. NTIS (U. S. Sales Only).

The connection of the minimal range between the shaped pulses and the RC shaper elements is investigated. Analytical expressions are obtained for the numerical determination of the calculated resolution time and reconstruction time after overload of an idealized shaping system. A program is suggested for determination of the times. The calculation results are presented in tables and graphs. (auth)

25688 (JINR-P13-6231) CURRENT REGULATOR FOR SUPERCONDUCTING SOLENOID. Kiselev, Yu. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

A compact precision current regulator for a superconducting solenoid with an automatic input-output system and fine current scanning is described. The current instability is 7.10^{-6} h^{-1}, and the current instability at the outer temperature changes is 2.10^{-6}/°C. (auth)

25689 (ORNL-TM-3692) PAPER TAPE TO TYPEWRITER TRANSLATOR THAT SUPPRESSES INSIGNIFICANT ZEROS. Perdue, P. T.; Thorngate, J. H. (Oak Ridge National Lab., Tenn.). Mar 1972. Contract W-7405-eng-26. 14p. Dep. NTIS.

A circuit is described which produces a typewriter listing of ASC II paper data tapes in a form that automatically removes all leading zeros and promotes rapid scanning of pulse-height-analyzer data to locate peaks. The last zero in an empty channel is always printed to locate the channel. A typewriter originally used with a multichannel analyzer was utilized as the printer. Full use is made of integrated circuits to reduce cost and circuit complexity. Reliability was established through operation over a period of six months. (3 figures) (auth)

25690 (RISO-M-1430) ELECTRONICS DEPARTMENT SEMI-ANNUAL REPORT FOR THE PERIOD 1 OCTOBER 1970–31 MARCH 1971. (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct 1971. 28p. Dep. NTIS (U. S. Sales Only).

A review is given of the activities of the department in the fields of instrumentation for Risoe experiments, measuring methods, and automation. Topics treated in special chapters are as follows: aneroid barometer, EDP in future Risoe instrumentations, nuclear geophysical methods, EDP system for a power station, optimization of system models, verbal record from trouble-shooting jobs. Publications and lectures by staff members are listed. (auth) (Denmark)

25691 (SC-DC-714529) SANDIA FIELD TEST QUARTZ GAGE, ITS CHARACTERISTICS AND DATA REDUCTION. Reed, R. P. (Sandia Labs., Albuquerque, N. Mex.). Jan 1972. 31p. (CONF-711208-9). Dep. NTIS.

From Underground nuclear test measurements symposium, Albuquerque, N. Mex. (7 Dec 1971).

The design and operating characteristics of a field gage to be used in the harsh environment of underground nuclear testing are described. The gage is electrically shielded and tolerant of radiation. Consequences of current distortion of the gage in data recording are illustrated, and means for improving the accuracy of data reduction for gages over a useful range of applications is briefly discussed. A simple procedure for selecting gages of standard design is also presented. (12 figures, 2 tables) (R.W.R.)

25692 HIGH SPEED TIME-TO-AMPLITUDE CONVERTER USING INTEGRATED CIRCUITS. Taylor, I. J.; Becker, T. H. (Columbia Univ., New York). Nucl. Instrum. Methods; 99: No. 2, 387-95(1972).

A high-speed TAC is described which is based on the use of integrated circuits. The TAC is of the start–stop type employing the Weisberg "delayed start" arrangement to permit sampling for valid coincidence time events before time-to-amplitude conversions are initiated. Circuit performance in terms of differential and integral nonlinearity is presented for a series of random time spectra. A pulse-pair resolution measurement indicates a time resolution capability of less than 60 ps for the TAC. (6 figures) (auth)

25693 GRAPHITE INSERT FOR A VARIAN ELECTRON GUN EVAPORATOR. Sokol, J. P. (Univ. of Notre Dame, Ind.). Nucl. Instrum. Methods; 99: No. 2, 379(1972).

A graphite insert was found effective when evaporating small samples in a Varian electron gun. (1 figure) (auth)

25694 ULTRASENSITIVE MAGNETIC FIELD MEASUREMENTS IN THE PRESENCE OF HIGH AMBIENT NOISE LEVELS: APPLICATION TO MAGNETOCARDIOGRAPHY. Rosen, A. (TRW Systems, Redondo Beach, Calif.); Inouye, G. T.; Morse, A. L.; Judge, D. L. J. Appl. Phys.; 43: No. 4, 1908-14(Apr 1972).

A two-junction superconducting Josephson tunneling magnetometer was developed for the measurement of magnetic field strengths of the order of 10^{-9} G/Hz$^{\frac{1}{2}}$ in an unshielded environment. The application of the device to the measurement of the heart's magnetic signature, the magnetocardiogram, and the problems associated with the measurement techniques are discussed. It is demonstrated that the fine details of the heart's magnetic signature (the magnetocardiogram) can be resolved in real time in an unshielded environment. (auth)

25695 CHARGED-PARTICLE OSCILLATOR. McIlraith, A. H. (National Physical Lab., Teddington, Eng.). J. Vac. Sci. Technol.; 9: No. 1, 209-12(Jan-Feb 1972).
From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

The charged-particle oscillator is a device by means of which particles of one sign are confined to a limited volume solely by means of a static electric field. In one form it consists of a pair of positively charged wires surrounded by an earthed conducting cylinder. An electron released from rest within the cylinder follows a stable oscillatory path which always passes between the wires and which is up to 5 km in length. The properties of this device have been explored by experiment and by computation, and are discussed with particular reference to its use as a uhv gage of high sensitivity and as a low-pressure ion source. (auth)

25696 NEW DIRECTIONAL AND ENERGY FOCUSING TIME-OF-FLIGHT MASS SPECTROMETERS FOR SPECIAL TASKS IN VACUUM AND SURFACE PHYSICS. Poschenrieder, W. P.; Oetjen, G.-H. (Mas-Planck-Institut fuer Plasmaphysik, Garching, Ger.). J. Vac. Sci. Technol.; 9: No. 1, 212-15(Jan-Feb 1972).
From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

A description is given of a variety of new directionally focusing TOFMS with equal momentum or equal energy acceleration and with no first-order dependence on ion velocity in time of flight. This is achieved by combining linear drift spaces with magnetic or electrostatic sector fields. Mathematical expressions for velocity focusing are presented together with the requirements for directional focusing, and the characteristic values of a number of geometries which afford stigmatic imaging are given. With special configurations it is further possible to avoid any first-order dependence of resolution on slit width. Finally, the resolution is also strongly influenced by the different means of ion production and acceleration. TOFMS with magnetic sector fields and equal momentum acceleration seem well suited for gas analysis together with the coincidence method, while the combination of a sputtering ion source with an electrostatic instrument is particularly promising for the analysis of solids and surfaces. (auth)

25697 DESIGN OF A SMALL MAGNETIC-SECTOR MASS SPECTROMETER WITH REDUCED MASS DISCRIMINATION. Werner, H. W.; Venema, A.; Linssen, A. J. (Philips Gloeilampenfabrieken N. V., Eindhoven, Netherlands). J. Vac. Sci. Technol.; 9: No. 1, 216-19(Jan-Feb 1972).
From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

The design of a small, low-weight, single-focusing, magnetic-sector mass spectrometer is reported with radius of curvature r_m = 5 cm, angle of magnetic sector ϕ_m = 90°, intended for fast voltage scanning. The properties of this 90° instrument are compared to those of 60° and 180° instruments. The ion source of this spectrometer is the outcome of studies on ion extraction and transmission. It compares favorably with a conventional electron-impact source as regards mass discrimination when voltage scanning is used. The choice of 90° for the magnetic sector has enabled the use of a multiplier for ion detection without being compelled to reduce the influence of the magnetic field as required in 180° instruments. A resolution (10% valley) of 50 at mass 40, at a minimum detectable pressure of 4×10^{-14} torr = 5.3×10^{-12} Pa using a single channel multiplier has been obtained. (auth)

25698 REDUCTION OF DOPPLER-BROADENED LINE-WIDTHS IN BEAM-FOIL SPECTROSCOPY. Carriveau, G. W.; Doobov, M. H.; Hay, H. J.; Sofield, C. J. (Australian National Univ., Canberra). Nucl. Instrum. Methods; 99: No. 3, 439-43 (1972).

A previously suggested method of reducing line widths in beam–foil spectroscopy by accepting only parallel rays of light was tried and found to be effective. Some of the characteristic features of the method were investigated. No special equipment is required. (3 figures) (auth)

25699 LOW COST PHOTOTUBE AMPLIFIER. Cisneros, E. (Stanford Univ., Calif.). Nucl. Instrum. Methods; 99: No. 3, 541-5(1972).

Described in this note are two 8-channel amplifier modules particularly suited to multidetector systems where low cost and high packaging density are of particular importance. The circuit is discussed and all parameters of interest are included along with photos showing physical layouts. (7 figures, 2 tables) (auth)

25700 INEXPENSIVE ANALOGUE TO DIGITAL CONVERTOR FOR USE IN LARGE SYSTEMS. Baruch, J.; Brooke, G. (Univ. of Leeds, Eng.). Nucl. Instrum. Methods; 99: No. 3, 519-23(1972).

Two hundred fifty A to D convertors were built and operated for four years. The dynamic range is 1000 : 1, and linearity, better than 5%. The circuit uses minimum-cost components and is calibrated in one operation. The output dc level is a fault indicator. The circuit is gated, operates on only single-polarity pulses, and provides a prompt analog output for trigger and other requirements. The circuit is slow in conversion, being designed for use in cosmic ray experiments. Two further versions of the circuit are described, one with improved performance but more expensive than the original and the other for use in a NIM system. (6 figures) (auth)

25701 256 CHANNEL BUFFER STORE FOR COSMIC RAY EXPERIMENTS. Baruch, J.; Brooke, G.; Kellermann, E. W. (Univ. of Leeds, Eng.). Nucl. Instrum. Methods; 99: No. 3, 513-18(1972).

A data recording system was constructed which accepts 256 simultaneous inputs each over a dynamic range of 1000. A ferrite core matrix is used as a buffer store with a recording accuracy of ±3%. The output is on paper tape and consists of input pulse heights with corresponding channel numbers, the date, and the time. The system is complete with trigger and discriminator circuits. (5 figures, 1 table) (auth)

25702 EXPONENTIAL CLOCK. Baruch, J.; Brooke, G. (Univ. of Leeds, Eng.). Nucl. Instrum. Methods; 99: No. 3, 511-12(1972).

A function generator was constructed accepting input pulses at 5 MHz and producing output pulses such that the interval between these pulses increases approximately exponentially. The linearity and percentage error of such a generator are discussed. (2 figures) (auth)

25703 EQUAL-PATH TIME-OF-FLIGHT NEUTRON DIFFRACTION. Carpenter, J. M.; Sutton, J. D. (Univ. of Michigan, Ann Arbor). Nucl. Instrum. Methods; 99: No. 3, 453-60 (1972).

Measurements of the neutron diffraction patterns of liquids and noncrystalline solids with crystal spectrometer facilities and time-of-flight diffraction techniques are discussed. It is shown that measurements with an equal-path time-of-flight diffractometer generally provide the most accurate representation of a total diffraction pattern. The results of neutron diffraction measurements of vitreous silica with a crystal spectrometer and an equal-path time-of-flight diffractometer are contrasted. (auth)

25704 FIELD EFFECT TRANSISTORS (M.O.S. TYPE) IN NUCLEAR INSTRUMENTATION AMPLIFIERS. Hart, B. L. (North East London Polytechnic); Barker, R. W. J. J. Inst. Nucl. Eng.; 13: No. 1, 3-8(Jan-Feb 1972).

In nuclear reactor engineering a knowledge of neutron flux at specific locations is an essential requirement, since it determines the power level and safety of the plant. Historically, electrometer tubes were used in the earliest types of measuring apparatus. However, the advantages of solid state devices dictate their use wherever possible, and the electrometer tube is in the process of being replaced in many applications by Field Effect Transistors (f.e.t.s) and, in particular, those of the M.O.S. type (m.o.s.f.e.t.s). This paper considers the requirement for m.o.s.f.e.t.s, their basic operating principles and their application potentialities in nuclear instrumentation. (auth) (UK)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstract 25269.

25705 (AAEC/LIB/Bib-328) SEPARATION OF ISOTOPES, ESPECIALLY URANIUM ISOTOPES, BY THE SEPARATION NOZZLE PROCESS. A Bibliography. Newland, E. A. (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Feb 1972. 24p. Dep. NTIS (U. S. Sales Only).

A bibliography is presented on nozzle separation of isotopes, particularly uranium isotopes. The 126 references cited are arranged chronologically working backwards from 1971 to 1948. (L.C.L.)

25706 (GAT-T-1603) DESIGN OF A MULTIPLE AIR COOLED CONDENSER PROCESS WASTE HEAT REMOVAL SYSTEM. Neely, Robert S. (Goodyear Atomic Corp., Piketon, Ohio). 21 Mar 1970. Contract AT(33-2)-1. 77p. Dep. NTIS.

Thesis. Submitted to Ohio Univ., Athens.

Research directed to improvements in the heat removal system for the expanding gaseous diffusion industry is described. A solution of such a large scale waste heat removal problem utilizing air to realize economic and pollution control benefits has never been attempted. A promising preliminary design is offered with emphasis placed on the systems engineering approach to total problem solution. The area of greatest emphasis is that of a forced convection air-cooled process condenser. (J.R.D.)

25707 (GAT-T-1633) FAILURE ANALYSIS OF COMPRESSOR BLADE RELIABILITY BY THE STUDY OF THE ENERGY TRANSFER CONCEPT. Harbarger, Wayne (Goodyear Atomic Corp., Piketon, Ohio). 21 Mar 1970. Contract AT(33-2)-1. 98p. Dep. NTIS.

Thesis. Submitted to Univ. of Ohio, Athens.

A procedure of analysis is described which can be used to detect by statistical means the cause of fatigue failure. The hypothesis that the response to a driving stimulus can be lessened by changing the blades' resonant frequency is tested. During start-up or shut-down of the machine, the compressor and blades experience transient changes in operating conditions. These may be reflected in dynamic changes in expected reliability. Whenever gas surging occurs, the system possesses a surplus of energy. The time constants of the aerodynamic and thermal cycles are longer than the duration of the gas surge. However, the excess energy must be absorbed in some physical form for system integrity. The response time constants of the mechanical components (because of the magnitudes of their inertial and damping characteristics) are shorter. Results of the study show that the conversion of the surplus energy during a surge is reflected in the resonance of blades, if the correct magnitude and compatibility of blade vibratory responses exist. (auth)

25708 (GAT-T-1738) SYSTEMS ANALYSIS TECHNIQUE USED TO CORRELATE DUCTING PRESSURE LOSSES. Tomko, Kenneth M. (Goodyear Atomic Corp., Piketon, Ohio). 28 Aug 1971. Contract AT(33-2)-1. 37p. Dep. NTIS.

Thesis. Submitted to Ohio Univ., Athens.

A new method is presented for correlating pressure loss coefficients for various gases, particularly air and UF_6, flowing through ducts. This analytical method uses both fluid mechanics and systems analysis techniques. The numerical results were verified by experimental data for air and UF_6 flow in the test facility at the Oak Ridge Gaseous Diffusion Plant. (L.C.L.)

25709 (ORO-3913-1) SEPARATION OF BORON ISOTOPES BY DIRECT MODE, THERMAL PARAMETRIC PUMPING. Progress Report, June 1, 1969–May 31, 1970. Schroeder, Hans G.; Hamrin, C. E. Jr. (Kentucky Univ., Lexington. Dept. of Chemical Engineering). Contract AT(40-1)-3913. 67p. Dep. NTIS.

Thesis. Submitted by Hans G. Schroeder.

An apparatus and the corresponding procedure used in studying the possibility of separation of boron isotopes by direct mode thermal parametric pumping are described. The study is based on the exchange reaction $B^{10}F_3$ (gas) + $B^{11}F_3 \cdot$ DMSO (dimethyl sulfoxide) (solid) $\overset{K}{\rightleftharpoons}$ $B^{11}F_3$ (g) + $B^{10}F_3 \cdot$ DMSO (solid). The equilibrium constant K, expressed as a ratio of the isotope ratios in the two phases, was experimentally determined to have a temperature dependence in accordance with the expression $\ln K = -(11.325/T) + 0.077$. Parametric pumping experiments were conducted up to 60 cycles between approximately 215 and 300°K. Although the equilibrium constant does not vary appreciably over this range, the $B^{10}F_3$ mole fraction of the product was found to be up to 2% higher than the one of the original BF_3 supply. This corresponds to a separation factor of only about 1.028 but establishes the possibility for further work. In order to improve the separation, high pressure gas–solid systems or a liquid–solid system such as $B^{10}F_3$ Anisole (liquid) + $B^{11}F_3 \cdot$ DMSO (solid) $\rightleftharpoons$ $B^{11}F_3$ Anisole (l) + $B^{10}F_3$ DMSO (s) are recommended. (auth)

25710 (ORO-3913-2) PARAMETRIC PUMPING AND ITS APPLICATION TO THE SEPARATION OF ISOTOPES. Progress Report, June 1, 1970–May 31, 1971. Keshaviah, Vishwanath R.; Hamrin, C. E. Jr. (Kentucky Univ., Lexington. Dept. of Chemical Engineering). Contract AT(40-1)-3913. 108p. Dep. NTIS.

Thesis. Submitted by Vishwanath R. Keshaviah.

Various aspects of batch and continuous parametric pumping were studied with a view to applying this technique to the separation of isotopes. In particular, boron and hydrogen isotope systems were considered. The linear and nonlinear equilibrium theories of batch parametric pumping were contrasted and a graphical stepwise procedure for estimating separation factors in a nonlinear equilibrium situation is presented. An open parametric pump with continuous top feed was studied in relation to the separation of isotopes in a hydrogen-palladium system. Several BF_3 addition compounds were considered as possible donor candidates in a BF_3-donor isotope system. The best system for para-pumping was ethyl acetate which indicated potential separation factors of 10^5 in 100 cycles. (auth)

25711 CENTRIFUGAL SEPARATOR. (to Mitsubishi Jukogyo Kabushiki Kaisha). British Patent 1,259,874. 12 Jan 1972. Priority date 15 Feb 1968, Japan.

A high-speed centrifugal separator is described that is capable of continuously separating substances of little difference in specific gravity, such as ^{235}U and ^{238}U. The separator is composed of a casing and an integrated rotor rotatably supported within the casing. The rotor has a number of independent separating chambers, each in the form of an elongated hollow in the rotor at a position remote from the axis of rotation and substantially parallel with the axis of rotation. Each chamber has an opening for supply, an opening for discharge of light fraction, and an opening for discharge of heavy fraction. The heavy fraction discharge opening is farther from the axis of rotation than the supply opening and the light fraction discharge opening, and the rotor has passages that communicate the openings with the outside of the separator. (B.L.M.)

25712 METHOD AND APPARATUS FOR TREATING PRE-ENRICHED AMMONIA. Hartmann, Fortunat; Gisler, Hans Rudolf (to Sulzer Brothers, Ltd.). U. S. Patent 3,644,093. 22 Feb 1972. Priority date 8 May 1968, Switzerland.

The pre-enriched ammonia is delivered into the exchange column prior to the final enrichment stage and is placed into a material exchange with a portion of the deuterium-impoverished water from the rectifying column. The material exchange enriches the water with deuterium. The enriched water is then fed into an intermediate point in the rectifying column for final enrichment. (Official Gazette)

Isotopic Power Sources

Refer also to abstracts 25425–25427, 25430, and 25496.

25713 (ARCO-3057-8) RADIOISOTOPE POWERED CARDIAC PACEMAKER PROGRAM, PHASE II. Quarterly Progress Report, November 1, 1971–January 31, 1972. (ARCO Nuclear Co., Leechburg, Pa.). Contract AT(11-1)-3057. 37p. Dep. NTIS.

Progress is reported on preparations for the pilot production of radioisotope-powered cardiac pacemakers (RPCP). All the electronic circuit modules were delivered and placed on life test. Qualification testing for these modules was successfully completed. Recommendations were submitted for the minimum cremation environmental conditions that a heat source contained with an RCPC system must withstand. During this period a heat source specification for oxide fuel was established, 12 heat sources were delivered, pilot production began, 2 of the pilot production systems were implanted in dogs, and 15 pilot production nuclear batteries were completed and performance tested. The mean value of electrical power available for cardiac pacing was about 270 microwatts with some units producing almost 300 microwatts. Details are reported for life testing, environmental testing, thermocouple fabrication, and system fabrication, production and testing. (L.C.L.)

25714 (BNWL-1308-9) ISOTOPE DEVELOPMENT PROGRAMS QUARTERLY REPORT, NOVEMBER 1971-JANUARY 1972. Jarrett, J. H. (comp.) (Battelle Pacific Northwest Labs., Richland, Wash.). Feb 1972. Contract AT(45-1)-1830. 20p. Dep. NTIS.

Research results are reported on low cost Cs and Sr sources, and uses of purified fission product Xe, Rh, Pd, Ru, and Tc. Development of radiographic methods using ^{252}Cf is discussed along with advanced sources, circulatory support systems, and nuclear techniques for seabed exploration. (J.R.D.)

25715 (ORNL-4774) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING DECEMBER 31, 1971. Lamb, Eugene; Donnelly, R. G. (Oak Ridge National Lab., Tenn.). Mar 1972. Contract W-7405-eng-26. 36p. Dep. NTIS.

The emissivity of $^{244}Cm_2O_3$ is being determined as a function of the wavelength and temperature. A high-temperature vacuum furnace with TGA and DTA units were fabricated that will enable the kinetics of the reaction between Cm_2O_3 and the platinum-like metals to temperatures near 2000°C to be studied. Work continues on the preparation of microparticles for cermet development using loaded ion-exchange beads. Gadolinium is being used as a stand-in for curium in the development phase. Good-quality particles have been produced with Rexyn 102H and IRC-72 resins. The curium source test was disassembled after 644 days of operation at 1000 to 1200°C. The primary vacuum chamber was opened, and the capsule was removed and opened. The required number of fuel pellets for the $^{238}PuO_2$ Aging Experiment was hot-pressed and shipped to Donald W. Douglas Laboratories. The apparent vapor pressure of Tm_2O_3 at 1900°C using small and large Knudsen cells is 1.90×10^{-7} and 1.03×10^{-7} atm, respectively. One-pound ingots of three Pt-Rh-W alloys have been fabricated into sheet by hot-rolling electron-beam-melted ingots. Of the three, the Pt-26% Rh-8% W alloy appears to be the most fabricable. Additional Pt-Rh-W alloys with small additions of hafnium and titanium have also been fabricated into sheet. In general, these alloys exhibit superior mechanical properties, particularly at elevated temperatures. The physical and mechanical properties of unalloyed iridium have been determined as a first step in an attempt to resolve problems of ductility and fabricability. The sensitivity of T-111 and molybdenum alloys to contaminants such as oxygen, water vapor, and other gases which are present in Pioneer radioisotope thermal generators has been determined. In general, the molybdenum alloys appear far less sensitive to these impurities than T-111. Nonfuel materials compatibility tests in support of the DART Program at Los Alamos have been completed and partially evaluated. Preliminary results indicate that tungsten interacts the least with graphite under the test conditions. (auth)

Radiation Sources

Refer also to abstract 25714.

25716 CONTROLLED ATMOSPHERE IRRADIATION CHAMBER. (to PPG Industries, Inc.). British Patent 1,259,930. 12 Jan 1972. Priority date 18 Aug 1969, United States.

An apparatus for treating products with ionizing radiation in a controlled atmosphere comprises a chamber having spaced outer walls with inlet and outlet openings for establishing a path of travel for the workpiece, a radiation-permeable window in the surface of the chamber and positioned over at least a part of the path of travel, at least one foraminous panel within the chamber defining a reservoir between the panel and an outer wall of the chamber, and means for introducing gas into the reservoir. (B.L.M.)

25717 APPLICATIONS OF RADIOISOTOPES IN ANALYSIS AND INDUSTRY. Simpson, H. (Atomic Energy Research Establishment, Harwell, Eng.). Rep. Progr. Appl. Chem.; 55: 673-85(1971).

A review is presented of some recent progress made in the use of radioisotopes under the following headings: uses of 14 MeV neutron generators (control of neutron energy; cyclic activation; neutron generators for "on stream" analysis; neutron activation analysis of human subjects); ^{252}Cf neutron sources; selective radiochemical removal of interfering elements; some current applications of neutron activation analysis; β autoradiography with the electron microscope; ^{238}Pu as a power source; and radiation detectors. (132 references) (UK)

Industrial Uses

Refer also to abstracts 25733, 25738, 25745, 25756, and 25765.

25718 (ORNL-IIC-28) ACTION OF γ RADIATION ON NONALCOHOLIC DRINKS, WINE, AND BRANDY. Bregvadze, U. D. Machine translation edited by Martha Gerrard and P. S. Baker (Oak Ridge National Lab., Tenn.), from Deistvie Gamma-Izlucheniya na Bezalkogol'ne Napitki i Vinno-Kon'yachne Izdeliya, Izdatel'stvo "Pishchevaya Promyshlennost'," Moscow, 1970. 103p. Dep. NTIS.

Five papers discuss applications of γ radiation processing of beverages. Studies on drinking water showed that unpleasant odor and taste of mineral waters are greatly reduced following exposure to 20 to 25 krads of γ radiation administered at a rate of 56 krads/min. Gamma irradiation (15 to 20 Mrads) increased the adsorptive capacity of gels used for water clarification. Gamma radiation of doses of 400 krads delivered at a dose rate of 56 krads/min destroyed the bulk of bacteria growing in semisweet wines and a dose of 600 krads completely sterilized semisweet wines and prevented further fermentation during storage. When freshly distilled brandy was γ irradiated at a dose of 400 to 500 kR and a dose rate of 140 R/min and oak chips added the taste was improved and the aroma and flavor resembled brandy aged for three years in an oak cask. Irradiation of old brandies resulted in a deterioration of flavor. Data on the optimum radiation dose for the processing of apple juice, cherry juice, apricot juice, tangerine juice, orange juice, lemon juice, peach juice, and pear juice for extension of storage life are presented. Sorbic acid was added to improve the organoleptic properties of the fruit juices. (263 references) (C.H.)

25719 GAMMA-IRRADIATION APPARATUS FOR GRANULAR MATERIAL. Kaushanskii, David Aronovich; Gurevich, Yakov Adolfovich; Zhukov, Boris Grigorievich; Srapeniants, Rigo Artemievich; Kalyanov, Dmitrii Maximovich (to Spetsialnoe Konstruktorskoe Byuro Instituta Organicheskoi Khimi). British Patent 1,263,638. 16 Feb 1972. Filed 16 Jun 1970.

Reference is made to apparatus particularly for irradiation of granular material of biological origin and having a particular application for irradiating seeds prior to sowing. A disadvantage of conventional batch apparatus is low handling capacity and low utilization of radiation. The apparatus described gives continuous operation by means of rotatable shaft extending through the center of the irradiation chamber. Portions of the shaft in the inlet opening and outlet opening are provided with shielding elements that cooperate with annular shielding projections on the shielding enclosure to provide an inlet and an outlet labyrinth. The shaft may hold an additional radiation source. The labyrinths may be provided with dampers, and the construction may allow an annular outlet of varying cross section. (UK)

25720 BIOLOGICAL INDICATOR FOR RADIOSTERILIZATION OF MEDICAL SUPPLIES AND COMPARISON OF THE MICROBIOLOGICAL EFFICIENCIES OF ^{60}Co PLANTS. Tanabe, Shiyun (National Inst. of Hygienic Sciences, Tokyo); Emborg, Claus; Nakano, Kazushiro. Radioisotopes (Tokyo); 20: No. 10, 498-504(Oct 1971). (In Japanese).

Streptococcus faecium A_z1, Bacillus sphaericus C_1A and spores of a strain classified as Bacillus cereus S6 were chosen as test strains for the control of radiosterilization procedure of disposable medical equipment. The biological indicators from these three microorganisms were used for comparison of the microbiological efficiencies of three cobalt-60 plants (Japanese 2, Danish 1). Identical doses of ionizing irradiation given at these plants have the same microbiological effect. A minimum dose of 4.5 Mrad is recommended if the contamination on the medical equipment to be sterilized is not known. If the initial count is known, a sterilization dose may be computed by means of the standard inactivation curves for the above three strains. (auth)

25721 STERILIZATION PROBLEMS OF SYNTHETIC BIOCOMPATIBLE MATERIALS. Bruck, Stephen D. (National Heart and Lung Inst., Bethesda, Md.). J. Biomed. Mater. Res.; 5: 139-58(May 1971).

The past, present, and future of biocompatible materials are reviewed as they relate to cardiovascular prostheses. Many of these materials are no longer simple systems and do not lend themselves to conventional steam or heat sterilization procedures by virtue of their lability. The object of this paper is to briefly discuss sterilization problems encountered with these labile materials using ionization radiation and gases, in terms of their physico-chemical structures. (auth)

LIFE SCIENCES

Refer also to abstract 27668.

Radiation Effects on Biochemicals (External Source)

Refer also to abstracts 25769, 25816, 25823, 25838, and 25854.

25722 (COO-1686-22) KINETIC AND BIOCHEMICAL ANALYSIS OF INTERACTING RADIATION RECOVERY SYSTEMS IN ESCHERICHIA COLI. Final Report. Friesen, Benjamin S. (Kansas Univ., Lawrence). [1970]. Contract AT(11-1)-1686. 38p. Dep. NTIS.

Studies were conducted on changes in the sensitivity of Escherichia coli to radiation and drugs when grown in glucose-enriched nutrient broth (glucose-induced resistance). Experiments are described on the induction and repair of gamma ray and methylmethanesulfonate-induced breaks in DNA of Escherichia coli. Host-cell reactivation of gamma-irradiated phage in E. coli and glucose-induced resistance of E. coli to mitomycin were investigated. An outline is presented for five kinds of evidence for the theory that glucose-induced resistance to mitomycin and to gamma radiation are not caused in the same way. Other studies were conducted on split-dose recovery, effects of caffeine and acriflavine on radiation and drug sensitivity, effects of combined ultraviolet and gamma radiation, and relationship between radioinduced DNA degradation and glucose-induced resistance. (H.L.W.)

25723 (EUR-4689) COMPUTER ANALYSIS AND RECONSTRUCTION OF ESR SPECTRA OF γ-IRRADIATED DNA. Gregoli, S.; Meelhuysen, R.; Bertinchamps, A. (European Atomic Energy Community, Ispra (Italy). European Scientific Data Processing Center. Brussels Univ. (Belgium)). 1971. 610p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 800.-.

Previous results suggest that in DNA γ-irradiated in the dry state at 25°C an electronic migration occurs which transforms the primary random radioproducts into new ones, localized essentially on the pyrimidine nucleotides, dTMP and dCMP. According to this mechanism, the ESR spectrum of irradiated DNA should consist of the weighted superimposition of pyrimidine patterns only. Conversely, starting from pyrimidine patterns only, it should be possible to reconstruct the ESR spectrum of DNA. To demonstrate this assumption we attempted first to isolate the constituent patterns from the dTMP and dCMP experimental spectra. While the dCMP spectrum, C, behaves like a single entity, the spectrum of dTMP was found to consist of the superimposition of three main patterns which we called τ_1, τ_2 and $\tau 3$. A computer program was prepared to perform a large number of linear combinations following the formula $\Delta = h_1\tau_1 + h_2\tau_2 + h_3\tau_3 + k\,C$, where the variable coefficients represent the relative intensity of the four elementary patterns in the resulting spectra Δ. We obtained in this manner an atlas of reconstructed spectra, all built up from the same pyrimidine patterns, but at different relative intensity. According to our hypothesis, for each experimental spectrum of DNA there should be an identical one among the reconstructed spectra. A series of DNA spectra were successfully subjected to this test. For each of them the relative yields of the different pyrimidine radicals were hence determined by comparison. (auth)

25724 (UR-3490-6) PROTECTION OF DNA MOLECULES OF CULTURED MAMMALIAN CELLS FROM RADIATION-INDUCED SINGLE STRAND SCISSIONS BY VARIOUS ALCOHOLS AND SH-COMPOUNDS. Roots, R.; Okada, S. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [1971]. Contract AT(30-1)-1286. 29p. Dep. NTIS.

The addition of alcohols (methanol, ethanol, t-butanol, ethylene glycol, and glycerol), SH compounds (cysteamine, cysteine and mercaptoethanol) and cystamine protected DNA molecules of mammalian cells from radiation-induced single strand scissions. The protection afforded with these scavengers increased as their concentrations were increased but always only up to a certain maximum. The maximum protection was the same for all the alcohols and cystamine, but another maximum was found for all the SH compounds. The extent of radiation-induced single strand breaks can therefore be grouped into protectable and non-protectable fractions. In the protectable fraction, there is a linear relationship between the scavenger concentrations for half maximum protection and the reaction rate constants for the OH radical reacting with the scavengers. No such linear relationship was demonstrated with rate constants of H and e^-_{aq}. This leads us to the following suggestions: that the protectable fraction is mostly of indirect action, that the OH radical plays a major role in radiation-induced single strand breaks of DNA in cultured mammalian cells, that a major protection mechanism in indirect action is radical scavenging (or a competitive reaction), and that the protection mechanism by SH compounds may consist of radical scavenging as well as some other type of reaction(s) resulting in radiation protection. (auth)

25725 MOLECULAR NATURE OF GENE AND CHROMOSOME MUTATIONS INDUCED BY IONIZING RADIATION. Shal'nov, M. I. (Inst. of Biophysics, Moscow). Tsitol. Genet.; 5: No. 1, 77-88(Jan-Feb 1971). (In Russian).

In irradiated cell populations damage to nitrogen bases of DNA results in gene mutations and damage to sugar-phosphate chains results in chromosome mutations. It is pointed out that a knowledge of the mechanisms of nucleic acid radiolysis is important in understanding the molecular nature of radiation mutagenesis and that other factors such as replication, recombination, and suppression mechanisms are also involved. The molecular nature of changes giving selective advantages to mutant cells over normal ones for selection can be explained by the amino acid sequence analysis in the polypeptides of anomalous protein forms. The use of radioprotective agents that prevent death of irradiated cells and organisms may increase the protein yield of anomalous mutant forms. (H.L.W.)

25726 UTILIZATION OF HOST-CELL DNA BY VACCINIA VIRUS REPLICATING IN HeLa CELLS IRRADIATED INTRANUCLEARLY WITH TRITIUM. Oki, T.; Fujiwara, Y.; Heidelberger, C. (Univ. of Wisconsin. Madison). J. Gen. Virol.; 13: Pt. 3, 401-13(Dec 1971).

When HeLa cells were pre-labelled with tritiated thymidine and infected with the WR or IHD strain of vaccinia virus, the host-cell DNA was broken down and re-utilized for virus particle DNA biosynthesis. This did not occur in LM cells, and was not explained by pseudovirus particle formation. Utilization of host-cell DNA, pre-labelled with [^{14}C]-thymidine did not occur. It was concluded that breakdown and re-utilization of host-cell DNA in HeLa cells resulted from intranuclear irradiation of the cells. Under these circumstances there was a markedly increased activity in the cells of an exonuclease with a pH optimum of 9.2, a requirement for magnesium ion, and which used denatured DNA as a substrate. The activity of this enzyme in such cells was directly proportional to the amount of irradiation, measured as the specific activity of the pre-labelled host-cell DNA. Associated with the vaccinia virus particles obtained from intranuclearly irradiated HeLa cells was an alkaline DNase inhibited by magnesium ion. (auth) (UK)

25727 IN VIVO METHYLATION OF ESCHERICHIA COLI DNA FOLLOWING ULTRAVIOLET AND X-IRRADIATION. Whitfield, Bradford L.; Billen, Daniel (Univ. of Florida, Gainesville). J. Mol. Biol.; 63: No. 3, 363-72(14 Feb 1972).

Escherichia coli 15T$^-$ (555-7) was irradiated with ultraviolet light and x-rays and the DNA examined for quantitative and qualitative changes in the methylation pattern. DNA synthesized following ultraviolet irradiation was under-methylated by approximately 25% as compared to DNA from unirradiated cells. The ratio of 6-methyladenine to 5-methylcytosine was unchanged. DNA synthesized following x-irradiation was methylated about 15% more than normal with a slight increase in the 6-methyladenine to 5-methylcytosine ratio. No additional methylation or turnover of methyl groups could be detected in parental DNA present at the time of ultraviolet or x-irradiation. E. coli 15T$^-$ (555-7) synthesized "unmethylated DNA" by growth in the absence of methionine. Ultraviolet irradiation of cells containing unmethylated DNA did not quantitatively change the ability of the cells subsequently to methylate this DNA when methionine was added to the culture. The ratio of 6-methyladenine to 5-methylcytosine in both control and ultraviolet-irradiated cells changed from 1.8 ± 0.2 when examined 15 minutes after addition of methionine to 1.4 ± 0.1, the normal value, when examined one hour after methionine was added. (auth) (UK)

25728 ENZYMOHISTOCHEMICAL EXAMINATIONS OF KIDNEY AND LIVER OF JUVENILE ALBINO RATS AFTER WHOLE-BODY IRRADIATION. Rose, H.; Hecker, D.; Wenk, H. (Humboldt Univ., Berlin). Radiobiol.-Radiother.; 12: No. 4, 521-34(1971). (In German).

The enzymatic pattern of nine different oxidative and hydrolytic enzymes, respectively, in the kidney and liver was histochemically examined in 46 juvenile male Wistar rats under comparable conditions after a whole-body x irradiation with 600 R in dependence on

the time after irradiation. The examinations revealed that 24 hrs after irradiation, in both organs changes in activity compared with the controls cannot be found. There was also no radiation dependent change in enzyme activity for acid phosphatase, nonspecific esterase, ATPase, and AMPase in the following stages of examinations (3, 5, and 8 day after irradiation). From the 3 day after irradiation, a high increase of activity appeared for NADH-tetrazolium salt reductase, lactate and succinate dehydrogenase, cytochrome oxidase, and alkaline phosphatase in the main parts of the renal cortex. In the hepatic parenchyma, these enzymes show—except NADH-tetrazolium salt reductase and lactate dehydrogenase—also a considerable increase in activity compared with the control animals on the 3, 5, and 8 day after irradiation. The activity of NaDH-tetrazolium salt reductase and lactate dehydrogenase increased in hepatic parenchyma only on the 3 and 5 day, it has, however, markedly decreased on the 8 day after irradiation. The weights of organs have considerably decreased after irradiation compared with the controls. In the irradiated kidneys, the neogenetic cortical zone is already highly reduced on the 3 day after irradiation and perceptible as a narrow seam only on the 5 day. The possible causes of the radiation-induced enzymatic changes are discussed. (auth)

25729 EFFECT OF IONIZING RADIATION ON PECTIN METHYL ESTERASE IN SOLUTION. Sanner, Tore; Kovacs-Proszt, Gisela; Vas, Karoly (Central Food Research Inst., Budapest). Radiat. Res.; 49: No. 2, 300-10(Feb 1972).

Pectin methyl esterase from tomatoes was irradiated in dilute aqueous solution in the presence of air at 20°C. The enzyme was inactivated with a yield corresponding to G = 0.36. Evidence was obtained that the loss of activity was due to the interaction of OH radicals with the enzyme. Cations that activate the enzymatic hydrolysis of pectin did not affect the radiation sensitivity of the enzyme. The Michaelis Menten constant for the substrate pectin was unaffected by irradiation, while K_{CaCl_2} for the activating effect of calcium ions decreased on irradiation. The radiation inactivation was associated with a significant aftereffect. The relative extent of the aftereffect increased nearly proportionally with inactivation. The aftereffect was completed after 5 minutes at 55°C. The extent and rate of the aftereffect was independent of the presence of cysteamine and catalase. The enzyme showed an increased sensitivity to heat-denaturation after irradiation. The increased heat lability was associated with a decrease in ΔH^* and ΔS^* for heat-denaturation. Addition of cysteamine immediately after irradiation reduced the heat sensitivity to that of the unirradiated control while catalase had no effect on the heat-sensitivity. (auth)

25730 SELECTIVE FREE RADICAL REACTIONS WITH PROTEINS AND ENZYMES: THE INACTIVATION OF RIBONUCLEASE. Adams, G. E. (Mount Vernon Hospital, Middlesex, Eng.); Bisby, R. H.; Cundall, R. B.; Redpath, J. L.; Willson, R. L. Radiat. Res.; 49: No. 2, 290-9(Feb 1972).

The effect of free radicals derived from thiocyanate, bromide, and carbonate ions on the activity of ribonuclease were studied in neutral and alkaline solutions. Thiocyanate ions and, to a lesser extent, carbonate ions, protect ribonuclease against radioinduced inactivation, although the presence of bromide ions has little effect. The absolute rate constants for the reactions of these radical anions with ribonuclease were measured as a function of pH and salt concentration, and the transient absorption spectra of the reaction products were determined. The results suggest that damage to a histidine residue, or residues, leads directly to loss of activity and support previous conclusions that exposed tyrosine residues in the enzyme are not essential for activity. (auth)

25731 ENERGY TRANSFER BETWEEN PROTEIN AND DNA IN NUCLEOPROTEIN. Lillicrap, S. C.; Fielden, E. M. (Inst. of Cancer Research, Sutton, Eng.). Int. J. Radiat. Biol.; 21: No. 2, 137-44(Feb 1972).

The behavior of the excited states formed in DNA, protein, and nucleoprotein following exposure to ionizing irradiation was studied by observing the associated luminescence. Emission spectra and decay kinetics were recorded over a temperature range of 93°K to 300°K and from 5 μsec to 20 sec after the start of a 1.6 μsec electron pulse. The nucleohistone emission spectrum was from the DNA constituent, but its emission decay kinetics showed characteristics of both constituents. There appeared to be a transfer of excitation energy from histone to DNA at the level of the lowest triplet states, confirmed by measurements of the luminescence yields. A model, describing the electronic transitions following irradiation, is proposed to account for these results. (auth) (UK)

25732 INTERACTION BETWEEN ENZYMIC SYSTEMS AND IRRADIATED SUBSTRATES. Comorosan, S.; Cru, M.; Vieru, S. (Fundeni Hospital, Bucharest). Enzymologia; 42: No. 1, 31-43 (Jan 1972).

The interaction between lactate dehydrogenase and the corresponding uv irradiated substrate in vitro is described. Enzymic rate enhancements at well defined lactate and pyruvate irradiation doses are recorded. The S → S* transition realized within this experimental model presents a maximum yield at irradiations with λ = 546 nm and lower values for the substrates irradiations with light from the uv, blue, and red region. A particular long lifetime of this S*-state is recorded. Unexpected results were obtained when the dependence of the S → S* transition on the irradiation intensity was studied, suggesting for this experimental model a particular type of electromagnetic field coupling with the substrates molecules. (auth)

25733 PROPERTIES OF ACIDIC AND ALKALINE FRUCTOSE-1,6-DIPHOSPHATASE FROM γ-IRRADIATED BANANA. Surendranathan, K. K.; Nair, P. Madhusudanan (Bhabha Atomic Research Centre, Trombay, India). Phytochemistry; 11: No. 1, 119-25(Jan 1972).

Gamma irradiation of preclimacteric Dwarf Cavendish bananas at 35 krad caused a gradual activation of fructose-1,6-diphosphatase, which reached a maximal 5-fold increase in activity in 3 days. Two enzymic components showing activity in acid (pH 6.6) and alkali (pH 8.8) were separated by calcium phosphate gel adsorption and elution. Both the enzymes required Mg^{2+} ions for activity. The catalytic properties of acidic and alkaline FDPase were quite different. The alkaline enzyme was more sensitive towards the concentration of substrate, and allosteric inhibitor AMP. Activation by disulfide reagent and EDTA was observed only in the case of alkaline enzyme. (UK)

25734 DNA REPAIR IN THYMUS LYMPHOCYTES AFTER IRRADIATION. Scaife, J. F. (Kernforschungslage, Juelich, Ger.). Int. J. Radiat. Biol.; 21: No. 2, 197-200(Feb 1972).

X radiation of rat thymocytes in doses of up to 10,000 R, caused increasing formation of single strand breaks, repair taking place within a few hours. Ultraviolet irradiation produced no immediately detectable breaks. The effect of uv radiation (up to 5000 ergs/mm^2) on RNA synthesis was shown to be a rapid reduction in the degree of transcription with the lower doses, indicating base damage, with only very limited repair. RNA synthesis was only slightly affected with x ray doses of up to 10,000 R. It is suggested that thymus small lymphocytes may resemble cells derived from Xeroderma pigmentosum patients, characterized by a deficiency of enzymes necessary for the initial excision step in repair synthesis. (UK)

25735 BIOCHEMICAL EVALUATION OF THE RADIOPROTECTING PROPERTIES OF SHIRKHESHT. Rouhanizadeh, N.; Khalkali, Z. (Teheran Univ.). Radioprotection; 6: No. 4, 279-83(1971). (In French).

In order to investigate the radioprotecting properties of Shirkhesht, a nontoxic natural substance, a biochemical evaluation of the DNP in irradiated and nonirradiated animals was made. The sensitivity of the DNP complex to irradiation was investigated. The results indicate a considerable change in the DNP complex in irradiated tissues, and demonstrate the considerable radioprotective action (25 to 30%) of Shirkhesht, which can be administered orally. (France)

25736 INDUCED PRODUCTION OF INVERTASE IN SUGAR-BEET ROOT BY γ-IRRADIATION: ROLE OF RNA. Stone, B. P.; Cherry, Joe H. (Purdue Univ., Lafayette, Ind.). Planta; 102: No. 3, 179-89(1972).

Gamma irradiation dosages between 100 and 200 krad greatly stimulate the development of invertase activity in sugar beet tissue. However, exposure of tissue to 800 krad virtually eliminates the production of invertase. The production of the enzyme in control and irradiated tissue requires RNA and protein synthesis. Failure of 5-fluorouracil to inhibit the development of invertase implies that the synthesis of ribosomal RNA is not required for enzyme production. A close correlation between irradiation-stimulated methylation of sRNA and enzyme production is noted. It is suggested that the synthesis or modification of some RNA required for the translation of masked invertase RNA is stimulated by γ-irradiation. (auth)

25737 IONIC BASE RADICALS IN γ-IRRADIATED DNA. Graeslund, A.; Ehrenberg, A.; Rupprecht, A.; Stroem, G. (Univ. of Stockholm. Karolinska Institutet, Stockholm). Biochim. Biophys. Acta; 254: No. 1, 172-86(Nov 1971).

The free radicals induced by γ-irradiation at 77°K in moist oriented DNA have been studied by electron spin resonance. The hyperfine structure of the ESR spectra with the magnetic field of the spectrometer parallel and perpendicular to the DNA helix axis has been analyzed. Two radical components produced in comparable amounts with different line-widths and hyperfine coupling schemes have been observed. Possible radical models for the two components are given. Spectra simulations according to the proposed hyperfine coupling schemes give a reasonable fit to the ex-

perimental spectra. Due to the symmetry character, the spectra are assigned to DNA base radicals with the unpaired electron in a delocalized π-orbital. The interpretation of the hyperfine couplings is in agreement with the preliminary results of a study on the very slow exchange of carbon bound hydrogen for deuterium on the DNA bases. Spin densities are estimated from the observed coupling constants. From comparison with theoretical spin densities in the literature we have further assigned one component to an anionic radical on thymine (or cytosine), and the other one to a cationic radical on guanine (or cytosine). (auth)

25738 EVIDENCE FOR DE NOVO SYNTHESIS OF ASPARAGINE SYNTHETASE IN GAMMA-IRRADIATED POTATOES. Nair, P. M.; Sreenivasan, A. (Bhabha Atomic Research Centre, Trombay, India). Indian J. Biochem. Biophys.; 8: No. 4, 204-9(Dec 1971).

A ten-fold increase in asparagine synthetase (EC 6.3.1.1) activity was obtained in the bud tissue of potatoes within 5 hr after 10 krad gamma irradiation. This was followed by a rapid fall in this activity. Irradiated buds also showed an increased incorporation of ^{14}C leucine into their soluble protein during this period. Cycloheximide (5 μg/ml) and puromycin (25 μg/ml) inhibited this protein synthesis as well as enzyme activation to about 70 and 60% respectively. Actinomycin D (10 μg/ml) inhibited protein synthesis in irradiated buds to 70%, while no inhibition was observed with unirradiated buds. The enhancement of asparagine synthetase activity was also arrested to about 70% by actinomycin D. Purified asparagine synthetase showed a single band on polyacrylamide gel electrophoresis. A good correlation was obtained between the incorporation of [^{14}C]leucine into the enzyme fraction and increase in specific activity. (auth)

25739 EFFECT OF IONIZING RADIATION ON THE ABSORPTION AND FLUORESCENCE OF INSULIN AND TYROSINE SOLUTIONS IN THE ULTRAVIOLET SPECTRA REGION. Bezrukova, A. G.; Palatov, V. A. (Central Research Inst. of Roentgeno-Radiology, Leningrad). Biofizika; 16: No. 3, 541-4(May-Jun 1971). (In Russian).

The identical character of changes in absorption and fluorescence spectra of insulin and tyrosine after γ exposures of 5, 10, 25, 50, 100, 200, 500, and 1000 krad and of different pH-values of the irradiated solutions was noted. The radiation-induced spectroscopic changes in insulin seemed to be related to radiation effect on tyrosine. (auth)

25740 ELECTRON SPIN RESONANCE INVESTIGATIONS ON HIGH-ENERGY IRRADIATED AND UNIRRADIATED POTATO PEELS. Mehringer, W. Z. Lebensm.-Untersuch. Forsch.; 147: No. 5, 278-81(Dec 1971). (In German).

The number, its dependence on dose and the life time of radicals, as induced by high energy electron irradiation in potato peels, was measured. The results obtained are discussed as far as the identification of irradiation or radiation, induced chemical substances and the structure of the potato peel is concerned. Electron spin resonance spectrometry subsequent to irradiation is proposed as a general method of investigation of the physicochemical structure of foods. (auth)

25741 EFFECT OF IONIZING RADIATIONS ON THE GLUTATHIONE-REDUCTASE/GLUTATHIONE-PEROXIDASE EQUILIBRIUM. Stefan, Maria; Rusovici, Lelia; Capalna, S. Rev. Roum. Physiol.; 8: No. 5, 423-9(1971). (In French).

The activity of the glutathione-reductase (GSSG-R) and glutathione-peroxidase (GSH-Px) in the erythrocytes was studied in mice exposed to single doses of 50, 100, 250 and 500 R of x radiation. It was found that beyond an exposure of 50 R, the GSH-Px activity decreases from the first hour on, remaining low for the whole period of five days of the study. On the other hand, the GSSG-R is activated at the start of the irradiation and decreases gradually after 24 hours. At the same time of the modification of the activity of these enzymes which are responsible for the oxidation-reduction of the reduced glutathione (GSH) during the first hours of exposure to less than 500 R of x radiation, an increase of the GSH in the erythrocytes was observed, followed by a decrease after 24 hours. In animals exposed to 500 R, the GSH level in the erythrocytes was found to decrease progressively from the first hours on; GSH stability tests revealed obvious changes only in these animals. The role of glutathione and of the enzymes involved in its oxidation-reduction reactions in the prevention of radiation injuries in the blood was examined. (TTT)

25742 ACTION OF GAMMA RADIATION ON THE SECONDARY STRUCTURE OF DNA FROM COTTON SEED. Ibragimov, A. P.; Aripdzhanov, Sh. A.; Divavin, I. A.; Usmanov, T.; Madumarov, A. K. (Inst. of Biochemistry, Tashkent). Uzb. Biol. Zh.; No. 4, 3-5(1971). (In Russian).

Radiation damage to the secondary structure of DNA was studied by methods involving removal of the DNA from cotton seeds in such a way that both concealed and obvious denaturation changes were exposed. Cotton seeds were irradiated with a ^{60}Co γ source with integral doses of 1, 6, 25, 50, and 100 kR. Melting points, viscosity, and hyperchromism were determined. With increased radiation dose the number of G–C hydrogen-bonded pairs increased, and saturation occurred at about 20 kR. A decreased rate of fusion after irradiation attested to a disturbance of the secondary structure of DNA. (K.S.W.)

25743 EXCITED STATES AND ENERGY TRANSFER IN BIOMOLECULAR SYSTEMS. Fielden, E. M.; Lillicrap, S. C. (Inst. of Cancer Research, Sutton, Eng.). Curr. Radiat. Res. Quart.; 7: No. 2, 133-80(Jan 1972).

The formation of excited and ionized molecules by the absorption of ionizing radiation is reviewed as an introduction to the role of these states as precursors of radiation injuries in biological materials. Excited states are conveniently monitored by the luminescence emission that is often associated with them. In an attempt to assess the importance of excited states in radiobiology the results of radioluminescence studies of many biomolecular systems are described. Particular emphasis is paid to the experimental method and results obtained by pulse irradiation techniques which enable the time dependence of the phenomena to be studied. The presence of trapping sites in many solid state cellular constituents markedly influences the emission kinetics and consequently the population of excited states following irradiation. It has also been demonstrated that in ordered biological structures and model systems there is efficient energy transfer over a considerable number of molecular diameters. In these systems, regions possessing low lying excited states or regions of high electron affinity act as efficient energy acceptors. This is particularly demonstrated by the case of DNA with incorporated 5BUdR, which is described in detail along with model systems that mimic its behavior. The possible relationship between excited state and energy transfer phenomena and radiobiological effects is discussed. (auth)

25744 EFFECT OF GAMMA RADIATION ON THE ASCORBIC ACID SYNTHESIS IN PEA AND COW PEA SEEDLINGS. Pathak, G. L.; Simlot, M. M. (Univ. of Udaipur, India). pp 255-65 of Radiation and Radioisotopes in Soil Studies and Plant Nutrition. Bombay; Dept. of Atomic Energy (1971).

From Symposium on radiation and radioisotopes in soil studies and plant nutrition; Bangalore, India (21 Dec 1970). See CONF-701227.

Cow pea, Vigna unguiculata, and pea, Pisum sativum, seeds were irradiated with gamma radiations at doses varying between 10 and 30 Kr. An increase in the ascorbic acid content of the seedlings grown from these seeds was observed regardless of whether the seeds were grown under dark or light. The increase in ascorbic acid was more pronounced in light. Effects of radiation on increased synthesis of ascorbic acid can be partly reversed by post treatment of the seeds with 1000 ppM gibberellic acid. The recovery in such cases comes to not more than 25% in light and 30% in dark. (auth)

25745 STABILITY AND CHARACTERISTICS OF THE PIGMENT PRODUCED BY GAMMA IRRADIATION OF METMYOGLOBIN. Satterlee, L. D. (Univ. of Nebraska, Lincoln); Brown, W. Duane; Lycometros, C. J. Food Sci.; 37: No. 2, 213-17(Mar-Apr 1972).

Possible reaction mechanisms involved in radioinduced changes in pigments of both fresh and cooked meats observed following radiation processing were investigated. Solutions of purified bovine metmyoglobin (MetMb), free of all heterogeneous myoglobin components, were irradiated in a ^{60}Co γ irradiator. The physicochemical properties of the irradiated pigment were determined with the aid of gel-filtration chromatography, gel electrophoresis, visible and infrared spectrophotometry, circular dichroism, and isoelectric focusing. The study showed that irradiation at dose levels higher than 200 Krad caused aggregation of the protein molecules. At a dose of 200 Krad the MetMb is converted into five separate oxymyoglobin (MbO_2) molecules. The heat, acid, and light stability of the MbO_2 produced upon irradiation differed dramatically from the stability of MbO_2 found in fresh red meat. (C.H.)

Radiation Effects on Cultured Cells (External Source)

Refer also to abstracts 25724–25726, 25734, and 25947.

25746 EFFECT OF 6-AZAURIDINE IN THE IRRADIATION OF TUMORS. Magdon, E. (Institut fuer Krebsforschung, Berlin). Radiobiol.-Radiother.; 12: No. 4, 535-44(1971). (In German).

The effect of 6-azauridine on the radiation-induced retardation of the growth of Yoshida-sarcomas, Ehrlich-carcinomas, benzpyrene-induced carcinomas, and on the growth and transplantability of spontaneous cancer of the breast was studied. The application of 6-azauridine before irradiation yielded a significant increase of the radiation effect in a strict dependence on the interval between 6-azauridine application and irradiation. In the evaluation of the experiments, a radiation intensifying factor was determined as a quotient of the irradiated tumors to those treated by 6-azauridine before irradiation as well as a factor of sensitization as a quotient of the tumors being treated by 6-azauridine after irradiation to those being treated by 6-azauridine before irradiation. The maximum intensifying and sensitizing effect was obtained when 6-azauridine was administered 24 hrs before irradiation. It was concluded from the results that the radiation sensitizing effect of 6-azauridine is due to a partial synchronisation as a consequence of which the main part of the cellular population at the time of irradiation is in a phase of maximum radiosensitivity. It was found by means of microautoradiographic examinations that 24 hrs after the application of 6-azauridine the incorporation of ^{3}H-thymidine into the DNA of ascites cells of Ehrlich-carcinoma is increased compared with the untreated cells. As first of all the labeling index is increased by the application of 6-azauridine, the assumption seems to be justified that after a blockage of the G_1 phase the early S-phase is the cellular stage that is responsible for the radiation sensitizing effect. (auth)

25747 COMPARISON OF MITOMYCIN C AND X-IRRADIATION AS BLOCKING AGENTS IN ONE-WAY MIXED LEUCOCYTE CULTURES. Bach, F. H.; Bach, M. L. (Univ. of Wisconsin, Madison). Nature (London) New Biol.; 235: No. 60, 243-4 (23 Feb 1972).

Mitomycin C and x-radiation were compared for unidirectional stimulation in the mixed leucocyte culture (MLC) test used as a measure of histocompatibility in man, and as an in vitro model for the recognition phase of homograft response. Results are presented of experiments done with unpurified cells used in the macro-MLC test and in the macro-method after purification of cells in Ficoll–Hypaque gradients to remove polymorphonuclear leucocytes and red blood cells. Both treatments gave satisfactory and comparable results. (UK)

25748 EFFECT OF CULTURING CONDITIONS ON RADIATION-INDUCED CYCLE DELAY IN SYNCHRONIZED CHO CELLS X-IRRADIATED IN G. Leeper, D. B.; Schneiderman, M. H.; Dewey, W. C. (Colorado State Univ., Fort Collins). Int. J. Radiat Biol.; 21: No. 2, 191-6(Feb 1972).

Division delay and delay into the S phase were studied as a function of culturing conditions in synchronized Chinese hamster (CHO) cells x-irradiated with 600 rads 1h after mitosis. Four culturing conditions were studied: monolayer, x ray, monolayer; monolayer, x ray, suspension; suspension, x ray, suspension; suspension, x ray, monolayer. The results indicated that radiation induced division delay was approximately 4 times greater than the delay into DNA synthesis, independent of culturing conditions. (UK)

25749 RADIATION DAMAGES IN ENERGY METABOLISM AND THEIR INVOLVEMENT IN INTERPHASE DEATH OF RAT THYMOCYTES. Yamada, T.; Ohyama, H. (National Inst. of Radiological Sciences, Chiba, Japan). Dobutsugaku Zasshi; 80: No. 4, 111-19(Apr 1971). (In Japanese).

When mechanism of radiation killing of living things is studied, death is classified into two kinds, i.e., reproductive death (mitotic death) of cells and interphase death (nonmitotic death). The interphase death is a mode of death in which irradiated cells die without direct relationship to cell division. Using convenient rat thymocytes, life and death of individual cells were judged by separative dying method, and investigations were made from many viewpoints, but reasonable explanations have not been made. It was confirmed that biological changes observed in the irradiated thymocytes were prevented by addition of adenine after the irradiation. Therefore, primary damage by radiation on the thymocytes is a reduction of intercellular ATP caused by adenine nucleotide decomposition. This causes various secondary metabolic damages, and may finally induce the interphase death. (KOBATAKE, H.) (Japan)

25750 TIME FACTOR IN RADIOBIOLOGY. Emery, E. W. (Royal Postgraduate Medical School, London). pp 1-12 of Advances in Medical Physics. /Laughlin, John S. (ed.). Boston; Second International Conference on Medical Physics, Inc. (1971).

From second international conference on medical physics; Boston Mass. (11 Aug 1969).

Data are reviewed from studies on the survival of Escherichia coli following irradiation with high energy electrons. The results indicated that high LET radiation delivered at low dose rates was more effective than when delivered at very high dose rates. The findings were attributed to chemical, rather than physical, reactions. Data are reviewed from studies on the survival of cultured Chinese hamster cells following irradiation with x radiation delivered as fractionated doses of 130 rads or 710 rads at various time intervals. The importance of the time interval between radiation doses was demonstrated. Studies on the growth and survival of transplanted mammary tumors in mice following exposure to fractionated doses of x radiation are reviewed that showed that tumor cells that remained capable of proliferation following irradiation were almost all hypoxic at the time of exposure. Implications of the findings in establishing dose schedules for radiotherapy of neoplasms are discussed briefly. (C.H.)

25751 STATISTICAL ASPECTS OF RADIATION ACTION. Kellerer, Albrecht M. (Columbia Univ., New York. Univ., Munich). pp 13-27 of Advances in Medical Physics. /Laughlin, John S. (ed.). Boston; Second International Conference on Medical Physics, Inc. (1971).

From second international conference on medical physics; Boston Mass. (11 Aug 1969).

The influence of physiological processes on the radiosensitivity of biological systems is discussed. Results of studies on the survival of synchronized and unsynchronized cultured mammalian cells following x irradiation are reported that emphasize the effects of cell phase on radiosensitivity. It is concluded that accurate cell survival probabilities cannot be derived for doses of x radiation below 50 rad. At a dose of 50 rads a cell is penetrated by several hundred ionizing particles and at this dose range the probabilities of cell division following irradiation are well defined as a function of dose without being influenced by statistical fluctuations. It is suggested that for doses below 50 rads mathematical analysis based on the moment of the dose response and the stage in the cell generation cycle is necessary to obtain quantitative data on radiation dose response. It is pointed out that Monte Carlo studies based on the stochastic approach to cellular kinetics yield qualitative, rather than quantitative, data and lead to ambivalence in interpretation. (C.H.)

25752 REPAIR REPLICATION AND UNSCHEDULED DNA SYNTHESIS IN SYNCHRONOUS MAMMALIAN CELLS. Richold, Margaret; Arlett, C. F. (Atomic Energy Research Establishment, Harwell, Eng.). Int. J. Radiat. Biol.; 21: No. 2, 127-36 (Feb 1972).

Mammalian cell populations (Chinese hamster and HeLa), synchronized by the excess thymidine double block technique, were irradiated in the G_2 phase of the mitotic cycle with uv or ^{60}Co radiations then pulsed with ^{3}H 5-bromo-2-deoxyuridine. Repair replication was demonstrated in each of the three cell lines investigated after uv-irradiation; but no evidence for repair was detected after ^{60}Co-irradiation. The extent of repair did not increase with dose. A correlation between repair replication and unscheduled DNA synthesis was observed. (auth) (UK)

25753 EFFECT OF IRRADIATION ON BLASTS DEVELOPED (PHYTOSTIMULATED) FROM PERIPHERAL BLOOD LYMPHOCYTES IN TISSUE CULTURE. Szirmai, E. (Blood Research Foundation Center, Tortona, Italy); Astaldi, G.; Airo, R.; Costa, Cr.; Celander, D. R. J. Inst. Nucl. Eng.; 13: No. 1, 15-17(Jan-Feb 1972).

The influence of different x-ray doses over the range 0 to 600 R on the proliferation of stem-cells developed in tissue cultures with phyto-haemaglutinin from human blood lymphocytes was studied using the statmokinetic test. It had been previously shown that 20 R doses were inhibiting and f.i. 200 R doses reduced the proliferative activity to a third with respect to controls. The stem-cells were more responsive to the x rays than any other hematopoietic cells. Spleen irradiation appeared to temporarily remove the plasmatic factor present in chronic lymphatic leukemia (CLL), which is inhibiting for the immune response of peripheral blood lymphocytes. It was found that before irradiation during three days of culture, very low percentages of blasts were obtained, while after spleen irradiation high percentages of proliferative blast-like cells were obtained. (UK)

25754 CELLULAR RADIOBIOLOGY. Lawrence, C. W. Institute of Biology's Studies in Biology, No. 30. London; Arnold (1971). 60p. £0.60.

The subject is dealt with under the headings: origins and aims (the discovery of ionizing radiations and the beginning of radiobiology, cellular radiobiology), the nature of ionizing radiations and their interactions with matter (types of ionizing radiation, interactions between radiations and matter, units of radiation dose), the lethal effects of ionizing radiations (the nature and definition of cell death, the identity of the targets, dose-survival curves, the influence of radiation quality), the genetic effects of ionizing radiations (chromosome aberrations, gene mutations, the relation between genetic and lethal damage), the biochemical consequences of irradiation (radiation chemistry, direct and indirect

action, radiation damage in DNA), and modification of cellular injury (chemical and physiological modification, protective and sensitizing substances, repair of radiation damage). (UK)

25755 IONIZING RADIATIONS AND THE CELL CYCLE. Tolmach, L. J.; Weiss, Barbara G.; Hopwood, L. E. (Washington Univ., St. Louis). Fed. Proc.; 30: No. 6, 1742-51(Nov-Dec 1971).

The well-established effects of 220 kV x-rays on cultured HeLa S3 cells are reviewed briefly, and the dependence of cell killing on the age of the cell at the time of irradiation is discussed. More recent time-lapse cinemicrographic studies of cells irradiated with 500-rad doses in G_1 (or S) have shown that although all cells complete the subsequent division (and the next interphase), 25% are permanently arrested in the second postirradiation mitosis and suffer mitotic death. It appears that in this system and after moderate x-ray doses, lethal damage is preferentially expressed in mitosis. However, irradiation also inhibits the synthesis of DNA; inhibition is maximal about 2 hrs after irradiation and persists, though a full complement of DNA is ultimately synthesized. Moreover, synthesis in the subsequent generation is only about two-thirds of normal, on average, after irradiation with this dose, though the duration of S is normal. Synthesis appears to be deficient in all cells, but is more so (about one-third of normal) in those cells that undergo mitotic death. It is postulated that severely deficient DNA synthesis results from lesions in DNA that persist from the time of irradiation, and that these are directly related to permanent mitotic arrest. (auth)

Radiation Effects on Microorganisms (External Source)

Refer also to abstracts 25720, 25722, 25727, 25750, and 25864.

25756 (IAEA-R-551-F) RADIORESISTANCE OF AFLATOXINS IN FOODS. Final Report for the Period 1 August 1967–31 October 1969. Frank, H. K.; Muenzner, R.; Diehl, J. F.; Gruenewald, T. (International Atomic Energy Agency, Vienna (Austria)). May 1970. vp. INIS.

Aflatoxin production by Aspergillus flavus has been known for 10 yrs. Ten to 70% of the isolates of this genus appear to be toxic. It is not clear whether the substrate or the climate is most responsible for this high degree of toxicity. A practicable method for eliminating or destroying these toxins in food or feed is desirable. Because aflatoxins are sensitive to uv light in the presence of oxygen, experiments were conducted with ionizing radiation under various conditions. Aflatoxin preparations were irradiated in the dry state and dissolved in chloroform, water, or buffer of different pH. Also, strains of Aspergillus flavus were grown on bread and rice and irradiated with electrons or x rays in an attempt to simulate practical conditions. Aflatoxin B_1 and G_1 were measured as they form the biggest amount of the various aflatoxins produced. In addition, the susceptibility of toxic and non-toxic strains of Aspergillus flavus to repeated sublethal doses of irradiation and the influence of this mode of irradiation on the ability of the survivors to produce aflatoxins under optimum conditions was examined. The results show that destruction of aflatoxins in foodstuffs by irradiation is difficult. The required doses are so high that the resultant radiochemical alterations of the food are intolerable. The detoxification of feedstuffs, however, especially protein concentrates might not be impossible in combination with other methods. Furthermore, it appears unlikely that a correlation between sublethal radiation doses and toxin production exists. (INIS)

25757 (TID-25965) SANDIA LABORATORIES QUARTERLY REPORT: PLANETARY QUARANTINE PROGRAM. Twenty-third Quarterly Report of Progress for Period Ending December 31, 1971. (Sandia Labs., Albuquerque, N. Mex.). Contract W-12,853. 61p. Dep. NTIS.

An irradiation facility was designed which approximates the irradiation conditions expected in space with regard to uv solar flux and vacuum. Survival data for Bacillus subtilis spores and for suspensions of microorganisms occurring naturally in Cape Kennedy soil irradiated in the facility are presented. The results indicate that the vacuum effect alone had a slight capacity to inactivate microorganisms. There was a dramatic difference in the response of spores of B. subtilis and Cape Kennedy soil microorganisms. Spores of B. subtilis were essentially completely inactivated after exposure for 24 hr to vacuum and uv radiation, while bacteria in the soil preparations survived for up to six days. Possible explanations for the difference in radiosensitivity are discussed. (C.H.)

25758 (UR-3490-35) DEMONSTRATION OF THE UAA OCHRE CODON IN BAKERS' YEAST BY AMINO ACID REPLACEMENTS IN ISO-1-CYTOCHROME c. Stewart, John W.; Sherman, Fred; Jackson, Mary; Thomas, Fred L. X.; Shipman, Nancy (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [1971]. 33p. Dep. NTIS.

Iso-1-cytochrome c from 45 intragenic revertants of the cyl-9 mutant of bakers' yeast (Saccharomyces sp.) are altered only by replacement of glutamic acid-2 with one of six amino acids. The replacement amino acids and the genetic code identify the cyl-9 lesion as a base pair substitution creating UAA at the mRNA template for position 2. Since, in addition, the cyl-9 mutant lacks iso-1-cytochrome c but can be suppressed by super-suppressor genes, this UAA triplet is a nonsense codon in yeast. The absence of other amino acids among the replacements suggests that UGA also is a nonsense codon in yeast. When acting to revert the cyl-9 UAA nonsense lesion, x rays, some alkylating chemicals, and spontaneous events cause substitutions of A · T pairs with no apparent selectivity, whereas uv irradiation and nitrous acid selectively induce A · T → G · C. Single substitutions account for all 45 reversions either obtained spontaneously or induced by eight different mutagenic treatments. (auth)

25759 ALTERATION IN THE RADIOSENSITIVITY OF ESCHERICHIA COLI $15T^-$ THROUGH THE INDUCTION OF UNBALANCED GROWTH BY CYSTEINE. Nagy, Zsolt (Univ., Debrecen, Hungary); Quintiliani, Marcello. Ann. Ist. Super. Sanita; 7: 37-43 (1971).

Gamma-ray sensitivity of Escherichia coli $15T^-$ was studied after 45 min incubation in a basal synthetic medium containing either 6×10^{-3} M cysteine, or 1.3×10^{-1} M hydroxyurea or else deprived of the source of energy (glucose). During such treatments growth rate, DNA synthesis and the number of viable cells were also investigated. All treatments resulted approximately in the same degree of growth rate inhibition. Increased radioresistance was observed after cysteine treatment and glucose deprivation. With these treatments, for a certain time, DNA synthesis was maintained and the number of viable cells increased. Treatment with hydroxyurea did not change the sensitivity to radiation, while DNA synthesis and the increase of viable cell number were immediately stopped. (auth)

25760 HIGH SUSCEPTIBILITY OF AN X-RAY SENSITIVE E. COLI STRAIN TO SINGLE-STRAND BREAKS IN DNA. Kato, Takesi (Osaka Univ.). Gamma Field Symp.; No. 8, 1-15(Aug 1970).

New evidence is presented to show that DNA polymerase is involved in repair of single-strand breaks and other unknown lesions induced by x-ray in DNA. An x-ray sensitive strain R15 and a wild type strain H/r 30R were used, and bacteriophages used were T4 and T1. Bacteria were labelled with ^3H, while the phages were labelled with ^{32}P. X-ray reduced the molecular weight of DNA in the wild strain as well as the strain R15, and there was a linear relationship between the number of the single-strand breaks induced and x-ray dose for both strains, but the R15 was about 3 times more sensitive to x-ray than the H/r 30R. High yield of the single strand breaks in the R 15 is not due to intrinsic nature of DNA, but to abnormal enzymatic action. Regulated activity of nuclease seems to be involved in wild type repair of the single strand breaks, and excessive nuclease activity shows up in the R 15 because of abortive repair of the strand breaks with defective resynthesis enzyme. Efficiency of the single-strand breakage in DNA by x-ray was 7.2×10^{-6}/rad/10^6 dalton and 2.3×10^{-6}/rad/10^6 dalton for the strains R15 and H/r 30 R, respectively. It is concluded that DNA polymerase participates, at least partly, in the repair of x-ray induced single-strand breaks in DNA. (KOBATAKE, H.) (Japan)

25761 STUDIES OF RADIATION-SENSITIVE MUTANTS IN YEAST. Nakai, Sayaka (National Inst. of Radiological Sciences, Chiba, Japan). Gamma Field Symp.; No. 8, 17-31(Aug 1970).

Data on characteristics of radiation sensitive mutants in yeast with special reference to radiation-induced mutagenesis were summarized. The radiation sensitive mutants, especially dark-repair deficient mutants, may serve as materials to visualize the radiation-induced mutagenesis, since the repair process is intimately concerned with induced mutation. The yield of different types of uv-induced mutation was markedly higher than that in wild-type strain at equal dose. It indicated that premutational damage of these types of mutation was dark-repairable. Similarly, damage leading to uv-induced mitotic recombination was dark-repairable. The frequency of the induced mutation of addition-deletion type in x-ray sensitive strains was much higher than that in wild-type strains at equal doses, while other types of mutation were not significantly enhanced. Thus the role of rec-type repair induced mutagenesis will depend upon molecular types of alleles examined. Mutagenesis of catalase-decreasing

mutant to x-ray induced super-suppressor mutation increased over that in wild-type strain. It is supposed that indirect effects of ionizing radiation may associate with the radiation induced mutagenesis. (KOBATAKE, H.) (Japan)

25762 CHARACTERIZATION OF GENETIC CODING CHANGES IN BACTERIA, (ESCHERICHIA COLI), PRODUCED BY IONIZING RADIATION AND BY THE RADIOACTIVE DECAY OF INCORPORATED ^{3}H-LABELLED COMPOUNDS. Phillips, Stephen L.; Person, Stanley; Newton, Helen P. (Pennsylvania State Univ., University Park). Int. J. Radiat. Biol.; 21: No. 2, 159-66(Feb 1972).

The mutagen specificity of ionizing radiation from ^{60}Co γ rays and radioactive decay was examined, using tritium-labeled nucleic acid and protein precursors (^{3}H-methyl-thymidine; ^{3}H-6-uracil and ^{3}H-histidine). Specificity was determined through an examination of bacterial revertants, using a bacterium (Escherichia coli) containing a nonsense mutation in a gene for arginine biosynthesis. By using nonsense mutants of T4 as indicators, arginine revertants were divided into classes. The presumed amino-acid insertions for classes were assigned earlier. The base changes leading to the production of revertants in particular classes were derived from amino-acid insertions, using the genetic code and knowledge that nonsense suppressors arise by single base alterations in the DNA information specifying certain tRNA anticodons. The mutagenic agents studied were not specific; rather a broad spectrum of base changes was observed. For the tritium-labeled compounds used, percentage distributions of base changes were similar to those for external ionizing radiation. For all mutagens studied approximately 75% of the revertants originated as alterations in GC pairs, and of these GC → TA base changes predominated. (auth) (UK)

25763 MODIFICATION OF THE RADIATION SENSITIVITY OF BACTERIOPHAGE T7 BY O_2 AND N_2O. Gampel-Jobbagy, Zulema; Van de Walle, Claude; Powers, E. L. (Univ. of Texas, Austin). Int. J. Radiat. Biol.; 21: No. 2, 115-25(Feb 1972).

The radiation sensitivity of T7 suspensions was strongly dependent on chemical additives. The response to x-irradiation was compared in the presence of 100% N_2, 100% O_2 (e^-_{aq} and H· scavenger) and 100% N_2O and e^-_{aq} (scavenger that increases ·OH concentration), in the presence of a 10^{-3} dilution of medium and a 10^{-5} dilution (equivalent to medium free). Survival curves were frequently multicomponent, with sharp break points. In the 10^{-3} dilution, the order of radiation sensitivity at low doses was $k_L = N_2 > N_2O > O_2$, and at high doses, $k_H = O_2 \cong N_2O > N_2$. In the 10^{-5} dilution, or medium free, the order at low doses is $k_L = N_2O > N_2 \cong O_2$ with k_H difficult to define. It is concluded: the OH radical is an important damaging species for T7, and "O_2 protection" is an experimental artifact associated with impurities in the suspension. (UK)

25764 ISOLATION AND CHARACTERIZATION OF AN X-RAY-SENSITIVE ULTRAVIOLET-RESISTANT MUTANT OF ESCHERICHIA COLI. Glickman, B. W.; Zwenk, H.; Van Sluis, C. A.; Roersch, A. (Medical Biological Lab. TNO, Rijswijk, Netherlands, Leiden State Univ.). Biochim. Biophys. Acta; 254: No. 1, 144-54(Nov 1971).

The isolation and characterization of a new Escherichia coli mutant are described which shows increased sensitivity to x-rays but not to ultraviolet irradiation. The locus responsible has been named rorA and is located in the same region as recB and recC. The Ror mutant is Rec$^+$, Hcr$^+$ (for both ultraviolet and x-rays), Fil$^+$ and grows normally. Following x irradiation excessive breakdown of DNA was observed. The possible nature of the defect in the mutant strain is discussed. (auth)

25765 CONTROL OF SALMONELLAE IN DRIED EGGS BY MEANS OF IRRADIATION. Bomar, M. T. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Arch. Lebensmittelhyg.; 21: No. 5, 97-102(1970). (In German).

Egg powder was inoculated with Salmonella typhimurium, with 50 ml of Salmonella suspension (concentration 10^6–10^7 cells per ml) being given to 100 g egg powder. After drying in Petri dishes or test tubes, the samples were irradiated with a 10 MeV linear accelerator, the doses amounting to 10 to 1000 krads. Then the number of Salmonellae were counted in the samples and enriched media showed no difference to selective media. After an irradiation with 250 krads the number of Salmonellae was diminished by 99%, after 500 to 1000 krads by more than 99.9%. A prolonged storage of irradiated samples caused an increase of death rate. A storage of contaminated egg powder enhanced the radiation dose necessary for killing of bacteria. Salmonellae of a 2 d old culture were more radioresistant than those of a 50 d old one. Investigations on the importance of the medium in which the Salmonellae were irradiated indicated a radioprotective effect of substances with high N-content. (INIS)

25766 EFFECT OF FLIGHT CONDITIONS ON HYDROGENOMONAS RADIOSENSITIVITY. Abramova, V. M.; Benevolenskii, V. N.; Druzhinin, Yu. P. Kosm. Biol. Med.; 5: No. 6, 18-20(Nov-Dec 1971). (In Russian).

Investigations were carried out with respect to the effect of space flight conditions and prolonged ground-bound storage on the viability and radiosensitivity of Hydrogenomonas eutropha exposed in a water suspension. The radiosensitivity was measured during pre- and post-flight exposures to ^{60}Co γ radiation. The absolute number of cells with inactivated division declined slightly and their radiosensitivity decreased as a result of extended (up to 24 days) storage at melting ice temperature and room temperature. No distinct differences in the radiosensitivity of Hydrogenomonas bacteria used in the experiment and in the control were established. (auth)

25767 MAINTENANCE OF THE RADIATION EFFECT IN GAMMA-IRRADIATED YEASTS ON EARTH AND IN SPACE. Benevolenskii, V. N.; Kapul'tsevich, Yu. G.; Korogodin, V. I.; Chepelev, S. A. Kosm. Biol. Med.; 5: No. 6, 14-18(Nov-Dec 1971). (In Russian).

The effect of specific flight factors on pre-irradiated yeast cells (Saccharomyces ellipsoides) was studied. The six-day space flight produced insignificant effects on the realization and reparation of primary radiation damages and the development of previously formed injuries. The prolonged storage of cells in the state of inhibited metabolism influenced the radiation effects to a greater extent. (auth)

25768 PROCEDURES AND RESULTS OF RADIOBIOLOGICAL INVESTIGATIONS. Grigor'ev, Yu. G.; Benevolenskii, V. N.; Druzhinin, Yu. P. Kosm. Biol. Med.; 5: No. 6, 3-8(Nov-Dec 1971). (In Russian).

Radiobiological investigations, including pre- and post-space flight irradiation of biological specimens are reported. The experiments were performed with dormant yeast cells, hydrogen bacteria, and lettuce and pea seeds onboard the Cosmos-368 Earth artificial satellite. The analysis of certain radiation effects, including cell division inactivation, chromosome aberration induction, and growth stimulation and inhibition, showed no substantial modification of radiation damages in response to the non-radiation space environment. (auth)

25769 RAPID REPAIR OF LESIONS INDUCED BY 313 NM LIGHT IN BROMOURACIL-SUBSTITUTED DNA OF ESCHERICHIA COLI. Ley, R. D ; Setlow, R. B. (Univ. of Tennessee, Knoxville. Oak Ridge National Lab., Tenn.). Biochem. Biophys. Res. Commun.; 46: No. 3, 1089-94(16 Feb 1972).

Ultraviolet irradiation at 313 nm of bromouracil-substituted DNA in Escherichia coli resulted in the appearance of single-strand breaks (or alkali-labile bonds). Postirradiation incubation of the irradiated cells causes the rapid disappearance (90% in 10 min) of the breaks. This rapid repair also occurred in two radiation-sensitive mutants (uvrA and polA) of E. coli, but not when the cells were lysed prior to postirradiation incubation. The relevance of this observation to the bromouracil-photolysis method of detecting repair replication is discussed. (auth)

Radiation Effects on Plants (External Source)

Refer also to abstracts 25742 and 25768.

25770 EXPERIMENTAL STUDIES ON THE INDUCTION OF HAPLOID PARTHENOGENESIS IN DOUGLAS FIR AND THE EFFECTS OF RADIATION ON THE GERMINATION AND GROWTH OF DOUGLAS FIR POLLEN. Livingston, Gordon Kay. Seattle; Univ. of Washington (1971). 212p. University Microfilms Order No. 72-7383.

Thesis.

A systematic attempt was made to induce haploid sporophytes in selected trees of Douglas-fir [Psuedotsuga menziesii (Mirb.) Franco] by applying irradiated pollen or growth substances to receptive ovulate cones. Ten female parents were selected on the basis of their relatively high selfing ability and/or the presence of genetic markers. Based on comparison of cross- and self pollinated seed set, the selected parents were estimated to carry lethal equivalents ranging from 1.2 per gamete in the best selfer to 6.0 in the poorest. Assuming that haploid parthenogenesis followed the Poisson distribution, a lower acceptable limit of haploid frequency was set at 0.1 percent. Accordingly, the number of egg cells to be treated was calculated to satisfy the minimum requirements. A total of 70,000 egg cells were exposed to seven different treatments including four doses of irradiated pollen (4, 8,

16, and 32 Kr) and three growth substances, 5% gibberellic acid (GA), 5% indole butyric acid (IBA), and 8% naphthaleneacetic acid (NAA). Growth substances were applied in powder form with talc as a carrier. Out of the 70,000 ovules treated, 1,300 developed into filled seeds. The percentage of filled seed in the irradiated pollen treatments showed a dosage response ranging from a high of 16.8 at 4 Kr to a low of 0.16 at 32 Kr. Based on an average control performance of 66.8 percent filled seeds from nonirradiated pollen, the LD_{50} was calculated to be about 2.5 Kr. The ratio of small/normal embryos in filled seeds increased with increasing radiation dose. Filled seeds were even obtained from Ga and IBA treatments, but NAA consistently caused cone abortion. One tree containing a genetic marker showed evidence for apomixis, the seeds being derived most likely from diploid maternal tissue. Haploid success was scored on the basis of chromosome counts in root-tips from terminating seeds. No haploids were found among 570 seeds examined from all seven treatments. Nor were chromosomal aberrations detected among the diploids produced by irradiated pollen. Parallel experiments studying the effects of radiation on Douglas-fir pollen showed that gamma and x-rays stimulated pollen-tube growth proportionately to the dose. This unique finding was further substantiated by respiration data showing an increase in oxygen uptake up to 64 Kr, but a relative decrease above that dose. While ionizing radiation affected pollen-tube growth, it did not affect pollen germination. In contrast to ionizing radiation, uv-irradiation did not affect germination or growth. Cytological studies with the light microscope showed no structural changes in irradiated pollen up to 64 Kr. But doses of 128 and 256 Kr appeared to cause exfoliation of the outer layer of the intine wall during germination. A model is postulated suggesting the presence of an inhibitor in the pollen with a higher radiosensitivity than the enzymes it controls. With increasing radiation dose this inhibitor is preferentially inactivated, thereby promoting pollen-tube growth. (Diss. Abstr. Int., B)

25771 SECOND TYPE OF GAMMA-RAY SENSITIVE GENE RS_2 IN SOYBEAN GLYCINE MAX(L.) MERRILL. Takagi, Yutaka (Inst. of Radiation Breeding, Omiya, Japan). Gamma Field Symp.; No. 8. 83-94(Aug 1970).

Mendelian behavior of radiosensitivity characters in soybean varieties was investigated. Several hundred soybean varieties were subjected to γ irradiation and long term chronic irradiation, and their D_{50} were estimated. Comparison of D_{50} has resulted in grouping most of the soybean varieties into two distinct types, resistant and sensitive. Tachisuzunari is one of the most resistant varieties, and Shinmejiro is relatively sensitive to chronic irradiation. There were two different types: one is Goishishirobana, D_{50} of which in seed irradiation was lower than that of Tachisuzunari, and the other is Lexington which has an extremely small value of D_{50} in both irradiation. Sensitivity in the hybrid F_1 of Lexington X Shinmejiro, Goishishirobana X Tachisuzunari and Shinmejiro X Goishishirobana was investigated. The sensitivity of their F_2 was also determined. From results of irradiation on F_2 of three crosses, it can be reasonably postulated that there are at least two kinds of major genes concerned with differential radiosensitivity among the soybean varieties. The first type of gene reduces growth after the irradiation of seeds and seedlings in recessive homozygous state, and the second type of genes acts in recessive homozygous state in the seed irradiation only. More detailed analysis of behavior of rs_2 gene must be required, and is in the program after establishment of isogenic lines. (Japan)

25772 VARIETAL DIFFERENCES IN RADIOSENSITIVITY WITH SPECIAL REFERENCE TO DIFFERENT ASPECTS WITH DIFFERENT CROPS. Ukai, Yasuo; Yamashita, Atsushi (Inst. of Radiation Breeding, Omiya, Japan). Gamma Field Symp.; No. 8, 69-81(Aug 1970). (In Japanese).

Using six crop plants, namely Oryza sativa, Hordeum vulgare, Zea mays, Glycine max, Pisum sativum, and Phaseolus vulgaris, varietal difference in radiosensitivity of different crops was investigated with x-ray, and ^{137}Cs and ^{60}Co γ rays. Effects (D_{50}) on root growth and those on seedling growth were significantly different according to the varieties and among these crops. Frequency of chromosome damage in each of these crops except in rice, was correlative to the radiosensitivity as regards root growth depression, but in rice, there was no indication of correlation between the D_{50} for root growth and frequency of cells with chromosome bridges after a single exposure to 50 kR. Correlation between the radiosensitivity expressed after air-dried seed irradiation and presoaked seed and seedling irradiation was significant in presoaked rice and barley, but the correlation coefficients decreased as presoaking time increased. In peas and kidney beans, results were similar to those in rice and barley. To the contrary, in soybeans, two groups of the varieties differing in radiosensitivity in regard to root growth, seedling growth and chromosome damage after the air-dried seed irradiation, exhibited clear difference in the seedling growth after the irradiation of seedlings. The radiosensitivity of rice and barley as determined by the root growth depression was genetically dominant, while in soybeam, the rs gene influenced largely the difference of radiosensitivity. The results indicate that the mechanism and genetic system of the varietal difference in radiosensitivity of crops differ among different species. (Japan)

25773 MUTANTS OF MORNING GLORY PRODUCED BY RADIATION APPLICATION. Mizutani, N. (Kinki Univ., Osaka). Nogyo Oyobi Engei; 46: No. 5, 801-2(May 1971). (In Japanese).

Observations were made on morning-glory mutants produced by applying radiation. Average height of the plant is 23 cm, which is about $1/10$ of original morning-glory, and the plant is compact. The period between seeding and flowering time is very short, and it is only $1/2$ to $1/3$ that of the original morning-glory. The number of flowers is comparatively large and the flowering time is long, while damage by blight and noxious insects is small, and cultivation is easy. Because of the above merits, it will be widely cultivated in the future. (Japan)

25774 CHIMERISM OF THE TOMATO PLANT AFTER SEED IRRADIATION WITH FAST NEUTRONS. Verkerk, K. (Agricultural Univ., Wageningen, Netherlands). Neth. J. Agr. Sci.; 19: 197-203(1971).

Mutagenic irradiation of tomato seeds leads to a chimeric structure of the M_1 plants, also within the generative or sporocyte tissue. This chimerism was studied by harvesting seeds from the first two trusses of the main stem and of all side shoots below the second truss. The initial cells of each of the lower 5 to 7 side shoots are already laid down in the embryo, resulting in different mutant types in each of these side shoots. The plant part above approximately the 7th side shoot originates from the apical initial cells of the embryo, and from the 7th side shoot upwards sectors are formed from each cell in the growing-point. The higher in the plant, the smaller the number of cells forming the plant part. The number of sectors in the plant diminishes from 2 to 3 sectors at the level of the 7th leaf up to 1 and occasionally 2 sectors in the second truss. This suggests that the main growing-point contains 3 initial cells for forming the sporocyte tissue. To obtain the largest possible number of mutant types, seed should be collected from the lower plant parts. (auth)

25775 PRELIMINARY STUDIES ON TRANSFER OF RECTANGULAR BUNDLE SHAPE OF AN X-RAY INDUCED MUTANT OF CORCHORUS CAPSULARIS TO TWO STANDARD STRAINS, JRC-212 AND D-154. Singh, D. P.; Bose, S. (Jute Agricultural Research Inst., Barrackpore, India. Univ. of Calcutta). Sci. Cult. (Calcutta); 37: No. 8, 390-1(Aug 1971).

A patchy albino mutant with gummy patches on the leaves was obtained in the F_2 generation from the variety JRC-212 after treatment with 30 kr of x rays. The mutant was also characterized by a rectangular shape of fiber bundle. Crosses were made of the mutant with the high yielding strains, JRC-212 and D-154, and further experiments demonstrated that the rectangular shape of fiber bundle was transferred to the high yielding strains and that the undesirable patchy leaf character was eliminated. The rectangular shaped fiber bundles resulted in a 24 to 26% higher yield. (H.L.W.)

25776 INDUCED MUTAGENESIS IN RICE. I. SENSITIVITY AND CHLOROPHYL MUTATION RATE. Purushothaman, G. (Agricultural Coll., Madurai, India). Madras Agr. J.; 56: No. 3, 110-19(1969).

Two mutagens, x- and γ rays, applied at different doses (10, 20, 30, 40, 50, and 60 kR) to dry dormant seeds of Co. 13 resulted in the differential survival of seedlings without affecting the sprouting ability. The survival of seedlings was more drastically reduced at higher doses in treatments with γ rays than with x rays. The M_1 plants exhibited seed sterility to varying extent at maturity. The chlorophyll mutation rate ranged from 7.7 to 21.4% with x-doses ranging from 10 to 60 kR. The rate of mutations exhibited an increase with increase of dosage. The early formed spikes showed a higher rate of mutations than the late formed ones, but the spikes irrespective of the sequence of their emergence, showed a similarity in the type of mutations produced. The spectrum of chlorophyll mutations, comprising albino, xantha, viridis, and albo-viridis, remained unaltered, either by the dosage or by the type of mutagen. It was also evident that the mutation rate and spectrum were independent of M_1 plant seed fertility, indicating the desirability of selection of fertile M_1 plants for study of progenies. (Indian Sci. Abstr.)

25777 EFFECTS OF ALKALI TREATMENT AND GAMMA IRRADIATION ON THE CHEMICAL COMPOSITION AND IN VITRO RUMEN DIGESTIBILITY OF CERTAIN SPECIES OF WOOD. Huffman, J. G.; Kitts, W. D.; Krishnamurti, C. R. (Univ. of Brit-

ish Columbia, Vancouver). Can. J. Anim. Sci.; 51: No. 2, 457-64(Aug 1971).

Changes in the chemical composition and in vitro rumen digestibility of alder, fir, poplar, and sludge were studied after treatment with NaOH and gamma irradiation. Treatment with alkali increased the percentage of cellulose and acid detergent fiber (ADF) in all species of wood studied, whereas the average acid detergent lignin (ADL) content was not affected. Alkali treatment increased the in vitro dry matter disappearance (DMD) of alder and poplar, and increased the in vitro cellulose digestion of alder, poplar, and sludge. Samples of the four species of wood that were exposed to 1×10^8 or 2×10^8 rads of gamma irradiation were lower in cellulose, ADF, and ADL content than the untreated samples, or those exposed to 1×10^6 or 1×10^7 rads. In vitro DMD, cellulose digestion, and volatile fatty acid production were higher in samples of all four species exposed to 1×10^8 or 2×10^8 rads, than in untreated samples, or in those exposed to 1×10^6 or 1×10^7 rads. (auth)

25778 INFLUENCE OF GAMMA RADIATION ON THE RESISTANCE OF WHEAT TO STALK RUST AND MILDEW. Azimov, A. S. Uzb. Biol. Zh.; No. 4, 73(1971). (In Russian).

Seeds of hard and soft wheat varieties were subjected to ^{60}Co gamma radiation at doses of 1,000, 5,000, 10,000, and 15,000 R. It was established that variations in shoots from seed irradiated at 1,000, 5,000, and 10,000 R were the same as those from control seed, but the shoots from 15,000 R treated seed showed morphological changes. Wheat susceptibility to fungi causing rust and mildew was significantly decreased by 5,000 and 10,000 R exposures of seed, but not following exposure to 15,000 R. (K.S.W.)

25779 SOME GENETIC AND BIOCHEMICAL FEATURES OF RADIOINDUCED MUTANTS OF THE COTTON PLANT. Egamberdiev, A. E.; Paiziev, P.; Ibragimkhodzhaeva, M. P.; Aripdzhanov, Sh. A. (Inst. of Experimental Plant Biology, Tashkent). Uzb. Biol. Zh.; No. 4, 6-8(1971). (In Russian).

The effect of gamma radiation on cotton was evaluated by irradiating seeds in bolls of ages of one to 25 days with 1.5 kR doses. Plants were grown and examined for unusual features such as the number of fruiting branches, height, weight of the boll, fiber length, strength, and maturity, seed weight, nucleotide composition of the DNA, and number of G–C pairs. It was concluded that a number of morphological and biochemical characters of the cotton plant were altered by gamma radiation. A change in the nucleotide composition was noted only in pubescent forms of the plant. (K.S.W.)

25780 INFLUENCE OF FLIGHT FACTORS ON THE FORMATION OF ANOMALOUS METABOLITES AND THE ACTIVITY OF PLANT ENZYMES. Sharkovskii, P. A.; Miller, A. T.; Shaidorov, Yu. I.; Krustyn, A. O. Kosm. Biol. Med.; 5: No. 6, 36-8(Nov-Dec 1971). (In Russian).

The presence of anomalous metabolites and the activity of oxidation-reduction enzymes in plant tissues were used as criteria for the biological effect of ionizing radiation encountered during space flight. Alcohol extracts of the plants (flax, rape, and mustard) were polarographically analyzed for metabolites, and the activity of peroxidase and polyphenoloxidase was determined in plant tissue. The formation of anomalous metabolites after radiation doses which depressed plant growth was retarded in the initial stages, but later exceeded the levels found in the controls. (K.S.W.)

25781 CHANGES OF GROWTH PROCESSES IN IRRADIATED LETTUCE SEEDS. Shaidorov, Yu. I.; Miller, A. T.; Nikitina, I. V.; (and others). Kosm. Biol. Med.; 5: No. 6, 21-4(Nov-Dec 1971). (In Russian).

The effect of space flight environmental factors on the biological effects of gamma rays was studied with respect to lettuce seeds. It was shown that the flight exerted no substantial effect on the energy requirements for seed germination. The length of the primary root of specimens irradiated before flight was similar to that of ground controls. In terms of this test, flight factors increased the effectiveness of post-flight irradiation insignificantly. The influence of a synchronous exposure inhibited the weight of 30-day plants to the largest extent. Exposure of seed to all the dosages tested during flight resulted in a slight decline of the plant weight as compared with the laboratory control. (auth)

25782 FLIGHT EFFECTS ON RADIATION-INDUCED CHROMOSOME ABERRATIONS IN RESTING PEA SEEDS. Tsarapkin, L. S.; Alekseenko, L. V.; Tsarapkina, K. A. Kosm. Biol. Med.; 5: No. 6, 31-5(Nov-Dec 1971). (In Russian).

Resting pea seeds with a moisture content of 7.0 to 7.5% exposed preflight to ^{60}Co γ irradiation in doses of 5 and 10 krads were aboard the Cosmos-368 earth artificial satellite during the post-radiation period. Mitotic activity and chromosome aberrations in anaphases were determined in the root meristem during the first cycle of cell division after wetting. The percentage of dividing cells remained unaltered in spite of the exposures applied. The variance analysis of the cytogenetic data showed no effects of the environment during satellite flight, its ambient atmosphere, or delivery to the launching site. The damage level was related only to radiation doses. (auth)

25783 EFFECT OF FLIGHT FACTORS ON DORMANT LETTUCE SEEDS. Farber, Yu. V.; Nevzgodina, L. V.; Pap'yan, N. M.; Soboleva, T. N. Kosm. Biol. Med.; 5: No. 6, 24-31 (Nov-Dec 1971). (In Russian).

The effect of space flight environmental factors on γ irradiated and nonirradiated lettuce seeds was examined. The experiments were carried out using seeds with normal and increased levels of spontaneous and induced mutagenesis. The flight environment was shown to influence spontaneous and induced mutagenesis in lettuce seeds. (auth)

Radiation Effects on Animals (External Source)

Man

Refer also to abstract 27609.

25784 (AD–734209) RADIATION EFFECTS IN MAN: MANIFESTATIONS AND THERAPEUTIC EFFORTS. Annual Report, May 1, 1970–April 30, 1971. Saenger, Eugene L.; Silberstein, Edward B. (Cincinnati Univ., Ohio. Coll. of Medicine). 1 Oct 1971. Contract DASA01-69-C-0131. 97p. (DNA-2751-T). NTIS.

The goal of the program has been to obtain new information regarding the patho-physiologic, psychologic, immunologic, hematologic, and biochemical effects of total- and partial-body irradiation in human beings. The patients that are irradiated, all have inoperable, metastatic carcinoma but are in relatively good health, provide the opportunity to study multiple facets of the effects of radiation in man rather than in experimental animal. Many laboratories have discovered that the extrapolation of results from laboratory animals to man to be fraught with error. The data contained in this report will suggest several potential biological dosimeters previously considered to be of some value have not fulfilled this expectation. Several new biological dosimeters are under evaluation. (auth) (NTIS)

25785 (CEA-N–1486(1)) RCCA DOSIMETRIC STUDIES GROUP: OBJECTIVES, FACILITIES AVAILABLE, AND METHODS. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Nov 1971. 85p. (In French). Dep. NTIS (U. S. Sales Only).

The objectives of the study program on the radiological consequences of critical accidents are defined. The techniques adopted and the working methods used are described. (France)

25786 SALIVARY GLAND TUMORS IN ATOMIC BOMB SURVIVORS, HIROSHIMA–NAGASAKI, 1957 TO 1970. Belsky, Joseph L. (Atomic Bomb Casualty Commission, Hiroshima); Tachikawa, Kiyoshi; Cihak, Robert W.; Yamamoto, Tsutomu. J. Amer. Med. Ass.; 219: No. 7, 864-8(14 Feb 1972).

Salivary gland tumors were found to be increased more than fivefold among survivors of the atomic bombs who were exposed to high doses of radiation, compared with nonirradiated controls. Despite a small number of proven cases (22 in all), this finding was determined to be highly significant for the entire group and for histologically malignant types, but not for benign tumors. This represents a new finding in the search for late sequelae of the atomic bombs. In our study the prevalence of tumors was related to younger age at exposure, but not to the interval between exposure and diagnosis. There was no clear association between amount of A-bomb radiation and cell type. The present findings are compared with other reports concerned with radiation and salivary gland neoplasia. (auth)

25787 RELEASE OF MEMBRANE-BOUND CALCIUM BY RADIATION AND SULFHYDRYL REAGENTS. Tolberg, Adelaide B.; Macey, Robert I. (Univ. of California, Berkeley). Contract AT(11-1)-34 PA 136-15. J. Cell. Physiol.; 79: No. 1, 43-51(Feb 1972).

Effects of ionizing radiation and of sulfhydryl reagents on the ^{45}Ca binding of red cell membranes were studied. Corresponding effects of these agents on potassium leak from intact red cells were also determined. Essentially all the ^{45}Ca associated with the ghosts appeared to be bound. Calcium binding could be described by assuming two independent groups of binding sites with dissociation constants of about 6×10^{-6} M and 2×10^{-4} M. The

total binding capacity was about 2.5×10^{-4} moles/g ghost protein. Membrane calcium was decreased by radiation and by the two sulfhydryl reagents, p-chloromercuribenzoate (PCMB) and N-ethyl maleimide (NEM). The tightly bound calcium fraction appeared to be most affected by these agents. Changes in potassium leak evoked by varying doses of agents appeared to parallel effects on membrane calcium. These investigations suggest that the increased cation permeability observed after exposure of red cells to radiation or sulfhydryl reagents may be related to alterations in the calcium-binding properties of the cell membrane. (auth)

25788 RADIATION CANCERS AND A-BOMB SURVIVORS. Stewart, A. M. (Oxford Univ.). Lancet; 1: No. 7750, 588-9(11 Mar 1972).

It had been previously suggested that the observed deficit of solid tumors among child atomic bomb survivors who received less than 10 rads was both an artefact and a measure of how much the carcinogenic effects of radiation exposures had been underestimated. It is suggested that if this were correct, the population to be studied would be one exposed to living conditions in the bombed cities after 1945, but not irradiated. If, on this basis, the 10,729 children receiving less than 10 rads served as controls, there was a 14 fold excess of solid tumors among the 810 children who received more than 100 rads. (UK)

25789 STATE OF HEMATOPOIESIS IN LOCAL FRACTIONAL IRRADIATION. III. THE HEMATOPOIESIS AT REMOTE PERIODS AFTER IRRADIATION. Baisogolov, G. D.; Pavlov, V. V. (Scientific-Research Inst. of Medical Radiology, Moscow). Med. Radiol.; 16: No. 11, 40-4(Nov 1971). (In Russian).

Based on the investigation of hematopoiesis in irradiated and nonirradiated areas of the bone marrow in 45 oncological patients 1 to 36 months after the end of radiation therapy a conclusion is made on the relation of the persistence of radiation aplasia of the bone marrow to the total absorbed dose and to the definite range of doses (3000 ± 500 R) which are threshold ones. An increase of this range leads to a stable aplasia. In irradiation with lesser doses restoration of hematopoiesis is observed. The functional state of the nonirradiated bone marrow was normal when investigated 6 to 24 months after the end of irradiation. (auth)

25790 PREDNISOLONE AND MUSTINE IN PREVENTION OF TUMOUR SWELLING DURING PULMONARY IRRADIATION. Cameron, S. J.; Grant, I. W. B.; Pearson, J. G.; Marques, C. (Northern General Hospital, Edinburgh. Univ. of Edinburgh). Brit. Med. J.; 1: No. 5799, 535-7(26 Feb 1972).

The protective effect of preliminary treatment with prednisolone or mustine before irradiation was studied in 88 patients by serial estimations of forced expiratory volume and forced vital capacity. Twenty-three patients received prednisolone by mouth, 24 had mustine intravenously, and 41 had no preliminary treatment. Both prednisolone and mustine prevented a significant decline in ventilatory function due to tumor swelling, prednisolone being marginally superior. It is concluded that all patients at risk should be treated with oral prednisolone, 20 mg daily, for one day before and two days after the first fraction of irradiation. (auth) (UK)

25791 HUMAN GENETICS STUDIES IN AREAS OF HIGH NATURAL RADIATION. II. FIRST RESULTS OF AN INVESTIGATION IN BRAZIL. Freire-Maia, Ademar (Faculdade de Ciencias Medicas e Biologicas, Botucatu, Brazil). An. Acad. Brasil. Cienc.; 43: No. 2, 457-9(30 Jun 1971).

A project of human genetic studies has been undertaken in Brazilian areas of high natural radiation, and the preliminary results on the genetic load disclosed by inbreeding are briefly presented and discussed. No evidence of a heavier load of mutations in the irradiated populations was found, as determined using data on 42,500 pregnancies. Due to the methodology employed and the conditions of the survey, this result is not unexpected. It should not be considered however as indicating that natural radiation has no genetic effect. (auth)

25792 FORENSIC PATHOLOGIC CRITERIA FOR RADIATION DEATH. Warren, Shields (New England Deaconess Hospital, Boston). Contract AT(30-1)-3777. J. Forensic Sci.; 16: No. 2, 137-43(Apr 1971).

The history of exposure, the objective findings of induced radioactivity in case of neutron exposure, of body fluid changes, and of acute and chronic tissue changes, sometimes with neoplasia as a late manifestation of preceding acute or chronic radiation are presented. (auth)

25793 COMPLICATIONS OF ABDOMINAL IRRADIATION. Girvin, George W.; Schnug, G. Edward; Cavanagh, Charles R.; McGonigle, Dee J. Amer. Surg.; 37: 498-502(Aug 1971).

A review is presented of 16 patients that were seen in the last 15 yrs who had serious complications resulting from abdominal x-ray therapy administered in the treatment of cancer in various organs. This was largely irradiation enteritis and cystitis. Twelve of the patients have had either urinary or intestinal fistulas. These were the presenting symptoms or they developed after an exploration in the treatment of small bowel obstruction. Preferred treatment is resection or bypass of the involved abnormal tissue into an area of normal tissue by incisions through normal skin. A diverting colostomy or ureteral ileostomy is often necessary to protect the excisional and reparative procedures. Many of these patients will develop severe nutritional and metabolic disorders. The surgical treatment will offer a comfortable and useful life. (auth)

25794 MESENTERIC ANGIOGRAPHY IN PATIENTS WITH RADIATION INJURY OF THE BOWEL AFTER PELVIS IRRADIATION. Dencker, Hans (Univ. of Lund, Sweden); Holmdahl, Kaj H:Son; Lunderquist, Anders; Olivecrona, Hans; Tylen, Ulf. Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 114: No. 3, 476-81(Mar 1972).

The results of mesenteric angiography in six patients with radiation injuries of the rectum following therapy are reported. The angiographic findings differ in some respects from other bowel lesions where a differential diagnosis may be impossible with the conventional roentgen examination with barium. The findings are compared with previous experimental and clinical studies. (auth)

25795 PATHOLOGY OF RADIATION EFFECT OF NORMAL AND NEOPLASTIC TISSUE. JANEWAY LECTURE, 1971. Ackerman, Lauren V. (Washington Univ., St. Louis). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 114: No. 3, 447-59 (Mar 1972).

The need for the radiation therapist and pathologist to work together is emphasized. It is pointed out that pathologists are forced to be concerned with cancer, particularly in the United States, where in a busy modern general hospital at least 60% of the surgical specimens are either cancer or suspected cancer and radiation therapy has become an important specialty in the field of radiology with an increasing number of physicians restricting their practice to it. Too often the pathologist has no concept of the meaning or implication of irradiated tissue either normal or neoplastic, and many pathologists do not realize that the radiation changes of either normal tissue or cancer are directly dependent on various techniques used by the radiation therapist. Examples of radiation injuries to normal and neoplastic tissues during therapy are described. (C.H.)

25796 SEVERE RADIATION INJURIES OF THE STOMACH, SMALL INTESTINE, COLON, AND RECTUM. Roswit, Bernard; Malsky, Stanley J.; Reid, Cyprian B. (Veterans Administration Hospital, Bronx, N. Y.). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 114: No. 3, 460-75(Mar 1972).

In radiation therapy for the control of abdomino-pelvic cancer, there is a calculated risk of serious injury to gastrointestinal viscera in return for the benefits of health. Serious injury to these vital organs can give rise to acute and long-term suffering, disability, and even death. Several examples are presented to illustrate the clinical pattern, life history, and surgical management of these complications. Some of the technical and clinical factors which have a bearing on the frequency and severity of damage are carefully reviewed and analyzed. Guidelines are suggested for safer clinical practice to prevent or significantly modify the risk of serious early or late reactions. (auth)

25797 EFFECTS OF IRRADIATION ON THE NORMAL THYROID GLAND ^{131}I UPTAKE. Lanaro, Aldo E.; Bosch, Antonio; Frias, Zenaida (Gonzalez Martinez Hospital, San Juan, Puerto Rico. Univ. of Puerto Rico, San Juan). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 114: No. 3, 600-5 (Mar 1972).

The thyroid function was studied in a group of 25 patients undergoing γ radiotherapy for cancer of the head and neck, and whose thyroid was included, either entirely or partially, in the irradiation field. Iodine-131 uptake studies were done prior to irradiation, at the end of treatment, and at one, six, and 12 months afterwards. Patients whose entire thyroid was irradiated showed a marked decrease in uptake levels at the end of irradiation, followed by a recovery one month afterwards of up to 80% of the initial levels. Patients whose thyroid gland was only partially irradiated showed a moderate decrease in uptake values at the end of therapy, and a slow recovery which reached the initial levels six months afterwards. These early hypofunction effects may be explained as due to the inflammatory processes produced in thyroid tissue when subjected to irradiation. Because of the limited survival of patients in this series, many of whom had advanced primary or metastatic disease, late effects of irradiation upon the thyroid function could not be assessed. (auth)

25798 SWEAT GLAND CARCINOMA ARISING IN IRRADIATED SKIN. El-Domeiri, Ali A.; Huvos, Andrew G.; Beattie, Edward J. Jr. (Memorial Sloan-Kettering Cancer Center, New York). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 114: No. 3, 606-9(Mar 1972).

Sweat gland carcinoma developed in eight patients several years following exposure to therapeutic or occupational radiation. In all patients the irradiated region showed evidence of radiation changes. All grades of malignancy were encountered. Similar to patients with other sweat gland carcinomas, the prognosis correlates with the histologic grade of the tumor and lymph node involvement. (auth)

25799 PREVENTION OF CARCINOGENESIS CAUSED BY RADIATIONS. Bottino, Stanislao (Univ., Genoa). Atti Accad. Fisiocrit. Siena, Sez. Med.-Fis.; 17: 806-20(1968). (In Italian).

After a brief summary of the natural and artificial sources of ionizing radiation, the injuries caused by radiation are reviewed. The carcinogenetic and leukemiogenetic action of radiation is emphasized. A critical analysis is made of the official investigations of populations surviving atomic explosions. Problems relative to the administration of small doses and atmospheric contamination are discussed. The problem of dosimetric control is examined. The present status of Italian legislation and the activity of the S.I.R.M.M. in the regulation of the use of natural and artificial radiation sources are reviewed. (tr-auth)

25800 ASSESSMENT OF THE POSSIBLE RADIATION RISKS TO THE POPULATION FROM ENVIRONMENTAL CONTAMINATION. London; Her Majesty's Stationery Office (1966). 16p. Available from Pendragon House, Redwood City, Calif.

In a recent report to the International Commission on Radiological Protection (ICRP Committee I, 1966), data have been published that provide a better basis for the evaluation of the risks from exposure to radiation than has previously been available. These data are adopted in the following review, which re-evaluates the possible hazard to the population of the United Kingdom from environmental contamination—from nuclear weapon testing or other sources—in terms of the possible incidence of certain types of harmful effects, for example leukaemia. Such an evaluation is inevitably still tentative and is indicative only of the possible upper limits of risk. This review contains an estimate of the total doses that will arise from the fallout in this country from all weapons that have been tested up to the end of 1965, and estimates are given of the risks that may be associated with these doses. The applicability of remedial measures against fallout is also discussed. The recommendations published by the Medical Research Council in 1960 for the protection of the population against environmental contamination by radioactive substances, especially strontium-90, are reviewed in the light of these estimates, as are the recommendations made in 1962 in relation to problems created by the short-lived radioactive isotope iodine-131. Some additional data on the irradiation of bone marrow due to the incorporation of strontium-90 into bone are included. (auth)

25801 PRACTICAL VALUE OF CHROMOSOME ANALYSIS IN RADIATION PATHOLOGY. Visfeldt, Jakob. Ugeskr. Laeger; 133: 2233-5(12 Nov 1971). (In Danish).

Despite the fact that less than 15 yrs have elapsed since research into radiation-induced chromosome aberrations began, chromosome analyses today play an important role in clinical radiation pathology. The analyses are of practical value mainly within the following fields. Biological dosimetry. Chromosome analyses are indicated in cases of: Acute whole-body irradiation. Nuclear disasters (atom bomb explosions and experiments, reactor accidents etc.). Chromosome analyses of peripheral blood for calculation of average whole-body dose. Acute non-uniform or partial-body irradiation. Chromosome analyses of peripheral blood for calculation of equivalent whole-body dose. Suspected exposure to irradiation to an unknown extent. Generally in order to eliminate the suspicion. Analyses of peripheral blood. Chronic external irradiation. Mostly of workers in atomic power plants and personnel in radiotherapeutic departments. Analyses of peripheral blood in order to gain sufficient experience in the correlation between the chronic exposition and the incidence of chromosome aberrations. Chronic internal irradiation. First and foremost patients with isotopes, particularly ^{32}P-treated patients with primary polycythaemia. Registration of the incidence of chromosome aberrations in peripheral blood, and examination of bone marrow for clones with abnormal chromosome patterns, possibly with an increased tendency to malignancy. In vitro systems. Mainly of importance for basic experimental studies. (auth)

25802 DOSE ABSORBED BY THE SKIN FROM BETA AND BETA-GAMMA EMITTERS AND ITS CHANGE WITH DEPTH OF CONTAMINATION. Norets, T. A.; Il'in, L. A.; Shamov, V. N. (Leningrad Research Inst. of Radiation Hygiene). Med. Radiol.; 16: No. 10, 48-54(Oct 1971). (In Russian).

Absorbed radiation dose levels at various depths in human skin resulting from contamination by β and β, γ emitting radioisotopes were investigated. Doses were calculated using the Loevinger equation for isotopes with from 0.1 to 3.0 MeV maximum energy residing in thin layers on the surface of the skin. The magnitude and distribution of the absorbed dose in the skin, and consequently the extent of irradiation of the tissues were determined by the energy of the β radiation. Data from this study should be useful in prediction of the extent and character of radiation injuries of the skin. (tr-auth)

25803 RADIATION SAFETY OF MEDICAL PERSONNEL IN INTRACAVITY THERAPY. Korenkov, I. P.; Raifel, B. A.; Filimonova, N. I.; Yudin, V. I. Med. Radiol.; 16: No. 10, 42-4(Oct 1971). (In Russian).

Using a ring dosimeter and other dosimeters, 630 measurements were made of radiation doses received by medical personnel during the insertion of intracavity radiation sources. Whole-body doses averaged 890 ± 300 mR per year for doctors and nurses, which was significantly lower than the maximum permissible dose. Radiation doses received by the hand fluctuated between 1,300 ± 250 and 1,900 ± 120 mR during a two week period. (tr-auth)

25804 PROBABILITY OF DEVELOPMENT OF DIFFERENT RADIATION REACTIONS IN ROENTGENOLOGISTS AND RADIOLOGISTS. Golikov, V. Ya. Med. Radiol.; 16: No. 10, 36-42(Oct 1971). (In Russian).

Based upon data in the literature and the clinical picture of radiation reactions and dosimetric studies, the probability of somatic and genetic effects of radiation in roentgenologists and radiologists was calculated. A classification is proposed of occupations by the degree of probability of occurrence of these reactions. (auth)

25805 LOCAL HEPATITIS CAUSED BY IRRADIATION. Ortiz Berrocal, J.; Otero Luna, J.; Arnaiz Bueno, F.; (and others) (Centro Nacional de Investigaciones Medico-Quirurgicas, Madrid). Rev. Clin. Espan.; 121: No. 5, 451-6(15 Jun 1971). (In Spanish).

The consequences of liver irradiation in patients with Hodgkin's disease treated by x ray therapy were studied. It was concluded that ^{198}Au liver scanning is the only means for the clinical diagnosis of radioinduced injuries of the liver. (auth)

25806 LEUKEMIA IN ATOMIC BOMB SURVIVORS IN ABCC MASTER SAMPLE, HIROSHIMA, AND NAGASAKI, 1950–66. Ishimaru, Toranosuke; Hoshino, Takashi; Ichimaru, Michito; Okada, Hiromu; Tomiyasu, Takanori (Atomic Bomb Casualty Commission, Hiroshima). Hiroshima Igaku; 24: No. 10, 1009-35(Oct 1971). (In Japanese). (ABCC-TR-25-69).

An analytical study was made during the period October 1, 1950 to September 30, 1966 on the incidence of leukemia in A-bomb survivors in Hiroshima and Nagasaki. Fixed samples of survivors who inhabited these cities on the 1st of October 1950 were used as the basic material. The relationship between incidence of leukemia and radiative dose was examined using assumed values of the T65D dosage estimated from the survivors. It was again admitted that the risk of leukemia was higher in survivors who had significant doses of radiation. Even Hiroshima survivors who had been exposed to less than 50 rad had a greater risk of getting leukemia, and there seemed to be no threshold level. But in Nagasaki, in the case of gamma rays only, it was suggested that the threshold might be between 20 to 100. As there is a big difference in the ratios of gamma rays to neutron rays in the two cities, and as the biological effect of neutrons seems to be different from that of gamma rays, the comparison of the two cities is complicated. The risk of getting leukemia by irradiation depends on the victim's sex and age at the time of the A-bomb explosion. Especially when the radiation dose is more than 100 rad, those under 40 at the time of the A-bomb explosion appear to be more sensitive than old people. There were no new findings regarding the minimum latent period before leukemia occurred and its relationship to the radiation dose. The incidence of leukemia is generally, however, at a maximum five to seven years after the bombing and thereafter decreases. There is no proof of that even 15 to 21 years after the A-bomb explosion the incidence of leukemia has dropped to the normal level. (Japan)

25807 STUDY OF ACCIDENTAL HUMAN IRRADIATION ACCIDENT. Beninson, D.; Placer, A.; Vander Elst, E. (Comision Nacional de Energia Atomica, Buenos Aires). Radioprotection; 6: No. 4, 243-53(1971). (In French).

The accident described occurred in a refinery in the city of La Plata (Argentina) during the course of work in which the control was effected by gammagraphy. A 13 curie ^{137}Cs source dropped out from its shielding and was found by a workman who picked it up and put it into the pocket of his working overall. The dosimetric reconstruction and the pathology of the radiation injuries are presented. (France)

25808 OSTEORADIONECROSIS. Waite, Daniel E. (Univ. of Minnesota, Minneapolis). Minneapolis Dist. Dent. J.; 55: 29-34(1971).

Any patient undergoing radiation therapy for the treatment of head or neck cancer is entitled to the benefits derived from a tumor conference regarding the management of such cases. Each case is unique and must be managed according to individual merit. The dental practitioner may not only be called upon to assume the responsibility for the dental care of these patients prior to and following radiation therapy, but also may have been instrumental in detecting the lesion for which the patient has undergone treatment. The importance of a team approach in the management of head and neck cancer patients cannot be overemphasized. The oncologist might be regarded as the captain of the team with the pathologist, physician, dentist, and radiologist participating in their respective roles designed to afford the best possible therapy for each patient. The dentist plays a key role on the team as he must not only employ all his knowledge of preventive therapy measures, but also must be able to motivate his patient to carry out these practices. Fluoride treatments, prophylactic periodontal therapy, oral hygiene instruction, and normally routine operative care assume far more significant and important roles to the patient as well as the dentist, especially when these practices will often need to be maintained for the duration of the patient's life. Instructing and motivating the patient in proper home care including proper brushing, diet and nutrition, and use of the oral lavage are also the obligation and responsibility of the dentist. The sense of pride and reward which the dentist may experience by observing such patients recover successfully and comfortably reflects an optimum service provided by the dental practitioner and the profession of dentistry. (auth)

25809 FACTITIAL PROCTITIS: A RESTUDY AT THE UNIVERSITY OF MINNESOTA. Sherman, Lloyd F.; Prem, Konald A.; Mensheha, N. M. (Univ. of Minnesota, Minneapolis). Dis. Colon Rectum; 14: No. 4, 281-5(Jul-Aug 1971).

The term factitial proctitis is used to designate the pathologic phenomena sometimes found in the walls of the rectum following the extrarectal application of ^{226}Ra or a combination of radium and x rays in the treatment of lesions involving the pelvic structures other than the rectum. The incidence of factitial proctitis and the severity of the lesions have decreased (10 percent) in a group of patients, compared with a previously-studied group. The only changes in the treatment have been the methods of application and anchoring the radium-226 applicator with the patient under general anesthesia, and copious vaginal packing. The success of treatment of this condition with daily instillations of hydrocortisone retention enemas far surpassed that of treatment with the placebo in a double-blind study, and it was superior to the topical application of steroid in suppositories. Treatment was continued until considerable improvement was evident proctoscopically. The average duration of treatment was two to three months. No intestinal or septal perforation occurred in the study group, nor was any diversionary procedure (colostomy) necessary. However, close proctoscopic follow-up examinations at monthly intervals are mandatory when this treatment regimen is used. (auth)

25810 VESICOVAGINAL FISTULA AFTER RADIATION THERAPY. Daly, James W. (Univ. of Florida, Gainesville). J. Fla. Med. Ass.; 58: 25-6(Jun 1971).

This report concerns two patients who developed spontaneous vesicovaginal fistulae ten years after radiotherapy for carcinoma of the cervix. Both of these individuals had certain features in common which may shed some light on an aspect of radiation damage that is not generally appreciated and not well understood. (auth)

25811 RADIATION-INDUCED HEART DISEASE. CLINICAL AND EXPERIMENTAL ASPECTS. Stewart, J. Robert (Univ. of Utah, Salt Lake City); Fajardo, Luis F. Radiol. Clin. N. Amer.; 9: No. 3, 511-31(Dec 1971).

The heart traditionally has been considered to be radioresistant; however, careful analysis of 59 patients with heart injuries following radiation therapy to the thorax revealed examples of radiation-induced heart disease. In Hodgkin's disease, the incidence was 6.6%, and in breast carcinoma 4.5%. The pathology of radiation-induced heart disease is distinctive, but by no means specific. The hallmark of the late lesions in the pericardium and myocardium is fibrosis. On clinical grounds, an attempt was made to classify syndromes, realizing that there is considerable overlap in the course of many patients. Particularly, either of the late pericardial syndromes, acute pericarditis or chronic pericardial effusion, may progress to cardiac tamponade or constriction. It is of utmost importance to remain alert to the occurrence of radiation-induced heart injuries since they may often be treated satisfactorily. (41 references) (C.H.)

25812 TOTAL BODY IRRADIATION AND HUMAN CHROMOSOMES. II. CYTOGENETIC STUDIES OF THE CULTURED BONE MARROW CELLS SEVEN YEARS AFTER TOTAL BODY IRRADIATION. Goh, Kong-oo (Oak Ridge Associated Universities, Tenn.). Amer. J. Med. Sci.; 262: No. 1, 43-9(Jul 1971).

Chromosomal analysis of bone marrow cells from six patients exposed to total body irradiation seven years previously showed more chromosomal breaks and abnormal chromosomes than in normal persons. Different stem cell lines with different marker chromosomes, similar to those seen in leukemia or cancer, are present; none of the patients have these diseases. (19 references) (auth)

25813 CONSEQUENCES OF URETERAL IRRADIATION WITH SPECIAL REFERENCE TO SUBSEQUENT URETERAL INJURY. Alfert, H. J.; Gillenwater, J. Y. (Univ. of Virginia, Charlottesville). J. Urol.; 107: No. 3, 369-71(Mar 1972).

A significant number of late ureteral complications were observed in patients with recurrent carcinoma of the cervix who had radiation therapy using intracavitary radium and external cobalt 60 x radiation in combination. The progression of the acute radiation changes to chronic radiation ureteritis was not necessarily inexorable. Relatively complete healing with minimal scarring usually followed the acute stage. Partial or complete ureteral obstruction occurring shortly after irradiation has begun is a recognized syndrome and is most probably secondary to edema which is reversible. It usually appears three weeks after the initial radiation treatment and is present to some degree in 50 to 60% of cases. Important variables which appear to be instrumental in deciding the ultimate progression of this process are the presence of infection and the dose of radiation absorbed. (C.H.)

25814 PULMONARY RADIATION REACTIONS. Weir, Gordon J. Jr.; Michaelson, Sol M. Springfield, Ill.; Charles C Thomas, Publisher (1971). 92p. $6.75.

The literature on pathological changes induced in normal lungs following external irradiation is reviewed. Emphasis is placed on biochemical and morphological changes observed in human lungs within three to five years following exposure during radiotherapy of neoplasms in the thoracic region. Long-term reactions, such as induction of neoplasia, are included only to the extent that they reflect pulmonary reactions to radiation. Data from a large number of animal studies are summarized briefly. The dangers from extrapolation of animal data to man are discussed and it is pointed out that comparisons of the anatomy of the lungs of various animals showed that the closest approximation of human lung architecture is found in the horse and only domestic swine have respiratory tract glands somewhat similar to those of man. The treatment of radioinduced lung fibrosis and pneumonitis in human patients is discussed. It is stated that no definitive treatment has been found for either condition and the supportive treatment for both conditions is similar. (197 references) (C.H.)

25815 ELEMENTS DE BIOPHYSIQUE. VOLUME 2. RADIATIONS IONISANTES ET NON IONISANTES. OPTIQUE. BIOPHYSIQUE DE LA CIRCULATION. NOTIONS D'INFORMATIQUE. (Elements of Biophysics. Volume 2. Ionizing and Nonionizing Radiations. Optics. Biophysics of the Circulation. Elements of Computer Sciences. Gremy, Francois; Perrin, Jean. Paris; Flammarion Medecine–Sciences (1971). 765p.

Although primarily intended for students of medicine, this book may also be of interest to other students or those preparing for certain specialized certificates. The fundamental concepts reviewed concern: radiations, nuclear structure, radioactivity, x ray production, interactions of x ray photons and corpuscular radiations with matter, and the detection and measurements associated with radiations. The following subjects are presented: radiobiology, radiopathology, and the appropriate radioprotection rules, radiodiagnosis, and radiotherapy. Ideas on general physics are introduced, which relate to thermal radiations, relativity, physical properties of x rays and their applications in studying matter, nuclear reactions, fission and fusion, and medical applications of radioelements and nonionizing radiations. (France)

Vertebrates

Refer also to abstracts 25728, 25735, and 25746.

25816 (AD-733048) STRUCTURAL ABNORMALITIES OF HEPATIC GLYCOGENS ISOLATED FROM GAMMA IRRADIATED RATS. Sobocinski, P. Z.; Hartley, K. M. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Oct 1971. 17p. (AFRRI-SR-71-15). NTIS.

Glycogens from rat livers were isolated by mild extraction procedures 24 hours after a 1000-rad gamma ray whole-body dose to the animals and were analyzed by physical-chemical methods. Glycogens obtained from irradiated animals have a

higher average chain length and consequently a lower degree of branching than glycogens from nonirradiated animals. The biosynthesis of such an abnormal polysaccharide appears to be related to radiation-induced alterations in the relative activities of glycogen synthesizing enzymes that have been previously reported. (auth)

25817 (UR-3490-24) EFFECT OF RAT TUMOR ALLOGRAFTS ON THE BLOOD LEVEL OF PASSIVELY TRANSFERRED ALLOANTIBODIES. Buchsbaum, Donald J. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [1971]. 13p. Dep. NTIS.

High titers of transplantation antibodies, as measured by a hemagglutination test, were induced in Buffalo strain rats by repeated inoculations of a carcinogen-induced tumor maintained in Fischer-344 rats. This tumor grew in Buffalo rats immunosuppressed by x-irradiation and cortisone. When a gamma globulin fraction from polled immune serum was injected intravenously into such tumor bearing rats the antibody titer in blood declined more rapidly than in similar immunosuppressed rats without tumor transplants. (auth)

25818 (UR-3490-26) EFFECT OF EPSILON-AMINO-N-CAPROIC ACID (EACA) ON RADIATION-INDUCED INCREASE IN CAPILLARY PERMEABILITY. Eassa, Eassa-Helmy M.; Casarett, George W. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [1970]. 37p. Dep. NTIS.

Results of experiments showed that the minimal single x-ray exposure to induce visibly detectable leakage of the intravenously injected vital dye Pontamine Sky Blue 6-BX (increased capillary permeability) in locally irradiated rabbit skin, within 3 hours (initial period), was 450 R. The average time elapsing between irradiation and the first visible sign (blue dye flush) of increased capillary permeability, and also the duration of this initial period of increased capillary permeability, were inversely dose-dependent, becoming shorter with higher exposures. The peak intensity of this effect was directly dose-dependent. Epsilon-amino-n-caproic acid, injected intravenously (0.30 g/kg body weight) at various times within the period from an hour before to an hour after irradiation, decreased or completely abolished the initial (within hours) radiation-induced increase in capillary permeability. The effectiveness of the EACA was inversely related to the size of the radiation exposure and was most marked when given in the interval from 15 minutes before to 15 minutes after irradiation. Intravenous injection of EACA 15 minutes before irradiation (1,000 R) eliminated the second period (2 to 3 days) and reduced the degree and shortened the duration of the 3rd period (10 to 17 days) of increased capillary permeability. (auth)

25819 STUDIES OF IRRADIATED MOUSE POPULATIONS. IV. EFFECTS ON PRODUCTIVITY IN THE 7th TO 18th GENERATIONS. Luening, K. G. (Lab. of Radiation Genetics, Stockholm). Mutat. Res.; 14: No. 3, 331-44(Mar 1972).

From an inbred mouse CBA strain two populations were considered. In one the males of each generation were given 276 R acute x-rays to the gonads; the other was a non-irradiated control. The effect on spermatogonia was studied by postponing the mating until 90 days after the irradiation. The populations consisted of about 150 pairs each per generation. From the 3rd generation they were bred for 170 days. The analysis encompasses 18 generations. The data presented cover mainly generations 7–18. It is shown that the net productivity (weaned young per female) in the irradiated population was decreased by about the same amount from the 1st to the 18th generation. As all generations are irradiated this is called a first generation effect. The factors causing the inferiority have been analyzed and the contributions of each part estimated. The major factor was loss of all litters born (functionally sterile) 50%. The remaining are number of litters in fertile pairs 15%, litter size at birth 20%, proportion weaned litters 10% and surviving to weaning 5%. Of these factors the functionally sterile are considerably affected by the environment. (auth)

25820 EFFECTS OF ACUTE GAMMA RADIATION AND TEMPERATURE ON GROWTH AND SURVIVAL OF JUVENILE RAINBOW TROUT (SALMO GAIRDNERI). Edmundson, Eldon Hartzel Jr. Pullman, Wash.; Washington State Univ. (1971). 57p. University Microfilms Order No. 72-7644.

Thesis.

Effects of acute gamma radiation and temperature on survival and growth of juvenile rainbow trout (Salmo gairdneri) were studied in continuous flow aquaria utilizing a split-plot design. Fish fingerlings acclimated to 10°C were exposed to various doses of gamma radiation up to 1,000 Roentgen (R) and placed into filtered tap water at 10°, 15°, or 20°C. They were raised in one of these water temperatures for 28 days and fed 4% of their body weight in commercial fish food once per day. Survivors were weighed weekly and counted daily in the basic experiment. There were no statistically significant ($P \leq .05$) effects of temperature, radiation, or temperature-radiation interaction on survival and growth. It was concluded that the combined action of acute gamma radiation less than 1,000 R and temperature regimes studied does not noticeably affect growth and survival of juvenile rainbow trout. (Diss. Abstr. Int., B)

25821 GLUCOSE TOLERANCE AND HEMOPOIETIC CHANGES IN PREDIABETIC AND DIABETIC RATS AFTER WHOLE-BODY X-IRRADIATION. Trochimowicz, Henry John. Pittsburgh; Univ. of Pittsburgh (1971). 210p. University Microfilms Order No. 72-7913.

Thesis.

Since there are many similarities between the effects in animals of diabetes mellitus and exposure to whole-body x-irradiation, it was hypothesized that the response of diabetic animals to radiation insult might be exaggerated. The metabolic and hemopoietic similarities are discussed and compared for these insults. The research was conducted to determine if rats made prediabetic and diabetic with alloxan were especially sensitive to a single dose of whole body x-radiation (500 R). Changes in tolerance to glucose, hemopoietic indices, and body weight were the main parameters under observation during a 60-day post-irradiation period. Animals in two different age groups were studied— mature rats (normal, prediabetic, and diabetic) which were 130 days old at the time of radiation treatment, and immature rats (normal and prediabetic) 65 days old at the time of exposure to the same dose of x-radiation. In the mature groups, normal irradiated rats, when compared to non-irradiated controls, showed a sustained decrease in tolerance to glucose over the 60-day post-irradiation period. However, there was no consistent radiation treatment effect on glucose tolerance in mature prediabetic and diabetic animals, indicating no special sensitivity to radiation insult as a result of the glucose tolerance state of the animal. In the immature groups, no significant changes in glucose tolerance were seen in normal or prediabetic irradiated animals at any test interval after radiation treatment. Changes in body weight and various hemopoietic indices— total while blood cell count, lymphocyte count, neutrophil count, hematocrit, and others— were also observed in both mature and immature rats post-irradiation. These results are presented and discussed. Although changes in a few of these indices, hematocrit and lymphocyte count, for example, were found to be associated with both radiation treatment and prediabetic or diabetic state, no interaction between the two factors was noted in mature or in immature animals. (Diss. Abstr. Int., B)

25822 TRANSFORMATION OF ISADRINE AND TRYPTAMINE IN ORGANISM OF IRRADIATED ANIMALS. Shmuter, G. M. (Ukrainian Advanced Training Inst. for Doctors, Kharkov). Ukr. Biokhim. Zh.; 43: No. 6, 746-51(Nov-Dec 1971). (In Ukrainian).

The effect was studied of x-ray irradiation in doses of 806 and 1320 rad on the rate of isadrine and tryptamine disappearance in albino mice. The data obtained made it possible to suppose a monoaminoxidase and catechol-O-methyltransferase activity in experiments in vivo. Catechol-O-methyltransferase proved to be resistant to the effect of x-ray irradiation. Only at the height of the irradiation sickness of animals in a grave state disappearance of isadrine slows down (up to 40%). The rate of tryptamine disappearance in a dose of 1320 rad decreases in a day (by 19%), but at the height of irradiation sickness in animals it decreases by 69%, with irradiation in a dose of 806 rad metabolism of tryptamine is completely absent. Possible reasons and importance of the observed shifts are discussed. (auth)

25823 RADIOSENSITIVITY OF THE METABOLIC PATHWAYS OF INCORPORATION OF THYMIDINE-^{3}H AND URIDINE-^{3}H IN AMPHIBIAN EMBRYOS. Alexandre, H.; Brachet, J. (Univ., Brussels). Arch. Int. Physiol. Biochim.; 79: No. 4, 817-18(Oct 1971). (In French).

Normal pleurodele embryos were injected with thymidine-^{3}H and uridine-^{3}H in order to follow the effects of x radiation. Under the conditions of the experiment the synthesis of DNA was decreased by 85%, with an increase of the acid lability. The results confirm the incorporation of uridine in DNA. However, contrary to the autoradiographic observations made on the nucleus, uridine incorporation is less important than in RNA. The extremely great radiosensitivity of this metabolic pathway is confirmed. (K.S.W.)

25824 RADIATION-INDUCED DNA SYNTHESIS IN NUCLEI OF HEN ERYTHROCYTES REACTIVATED IN HETEROKARYONS. Darzynkiewicz, Z. (Boston Biomedical Research Inst.). Exp. Cell Res.; 69: No. 2, 477-81(Dec 1971).

Blood cells from 12-day old chick embryos were uv-irradiated and heterokaryons were prepared by fusing chick embryo erythrocytes with rat fibroblasts or HeLa cells using uv-inactivated

Sendai virus. Negligible amounts of ^{3}H-TdR were incorporated into uv-irradiated or unirradiated erythrocytes. However, the erythrocyte nuclei reactivated in heterokaryons responded to uv irradiation with an eight- to fifteen-fold increase in rate of ^{3}H-TdR incorporation. The exclusively nuclear localization, the stability of incorporated precursor to cold trichloroacetic acid treatment, and its removal by DNAase indicated that ^{3}H-TdR was incorporated into DNA. Mechanisms of DNA repair are discussed. (H.L.W.)

25825 ANTIBIOTIC THERAPY OF INTESTINAL PHASE OF RADIATION SICKNESS. Ermol'eva, Z. V.; Semenov, L. F.; Stasilevich, Z. K.; Zeitunyan, K. A. (Inst. of Experimental Pathology and Therapy, Moscow). Antibiotiki; 17: No. 1, 57-60 (Jan 1972). (In Russian).

The effect of antibiotics and some radioprotectors on development of bacteremia and microbial dissemination in the liver and spleen of irradiated mice during the intestine phase of radiation sickness was studied. It was shown that radioprotectors, such as PAPF, mexamine, and cystaphos had no effect on penetration of the microbes to the tissues of the mice on the 3rd day after the irradiation. Antibiotics decreased or completely prevented the development of bacteremia and bacterial dissemination in the inner organs of the irradiated mice. Chlortetracycline and streptomycin proved to be more effective in this respect than penicillin and ampicillin. (auth)

25826 KINETIC STUDY OF ENDOGENOUS-SPLEEN-COLONY-FORMING CELLS IN IRRADIATED MICE. Ueno, Y. (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi; 31: No. 1, 13-16(Apr 1971).

Ninety-day-old and 60-day-old female mice were given radiation of 400 R and then the D_0 and the n values of the endogenous-spleen-colony-forming cells (ESC-forming cells) were measured during the four hours following irradiation. The n values 30 minutes, 1, and 4 hours after irradiation were always less than 1.0, but the value 2 hours after irradiation was more than 8.0. On the other hand, the D_0 values of irradiated mice was larger than that of non-irradiated mice at 30 minutes, 1, and 4 hours later, and was small 2 hours later. These results were analysed. (Japan)

25827 SOME MECHANISMS OF THE DAMAGING EFFECT OF IRRADIATION AND OF RADIOMIMETIC AGENTS. Dolgov, E. G.; Oralbaev, K. O. (Semipalatinsk Medical Inst., USSR). Izv. Akad. Nauk Kaz. SSR, Ser. Biol.; No. 1, 56-9(Jan-Feb 1971).

Changes in the resistance of white rats to mercury dichloride (a typical thiotoxin) were studied at various intervals after whole-body x irradiation and administration of two alkylating agents belonging to chloroethylamines, namely sarcolysin and Thio-TEPA. The results have clearly demonstrated that endogenous thiols are indeed involved in the development of pathological changes after exposure to ionizing radiation and after administration of alkylating compounds. (JPRS)

25828 CLINICAL SIGNS OF RADIATION SICKNESS OF RATS AFTER IRRADIATION WITH GAMMA-RAY NEUTRON MIXED RADIATION WITH DIFFERENT FRACTION OF GAMMA-RADIATION. Saporov, V. N. Radiobiol.-Radiother.; 12: No. 4, 511-20(1971). (In German).

Three hundred and fifty male rats (18 to 40 animals each per dose) with a weight of 200 to 220 g were irradiated by gamma ray-neutron mixed radiation in the horizontal channel of the reactor IRT-5000 of the Institute of Atomic Energy I. V. Kurcatov at points corresponding to 18, 22, and 31% fractions of gamma radiation. The dose rates were correspondingly 4,7, 10, and 74 rad/min. The radiation doses were between 200 and 500 rad. It was found, by means of phantom dosimetry, that the slope of the absorbed dose of gamma-neutron radiation with 18 and 31% fraction of gamma-radiation was 1.7. The observations of the animals in a period of 30 days showed that frequency and degree of markedness of the clinical signs of radiation sickness depend on the height of the fraction of gamma-radiation in the total dose. With the increase of the fraction of gamma-radiation from 18 to 31% the degree of markedness and frequency of gastrointestinal disturbances decreases. The number of hemorrhages is insignificantly higher. The time of development of single signs is delayed; the death of the animals is observed at later times, the severity of the disease decreases and the peripheral blood is less damaged. Compared with gamma irradiation, a severer course of radiation sickness is found. (auth)

25829 INFLUENCE OF SEROTONIN ON THE RESISTANCE OF SKIN VESSELS OF GUINEA PIGS AT THE PEAK OF ACUTE RADIATION SICKNESS. Dorofeev, V. M.; Khnychev, S. S. (Inst. of Medical Radiology, Obninsk, USSR). Byull. Eksp. Biol. Med.; 73: No. 1, 31-3(Jan 1972). (In Russian).

Experiments were carried out on 119 guinea pigs of both sexes weighing 230 to 350 g. On the seventh day after irradiation with ^{60}Co gamma rays (600 R at 46 R/sec) creatinine sulfate serotonin (10 mg/kg) or 5-oxytryptophan (50 mg/kg) was administered. An increased content of serotonin in the blood was associated with an increased resistance of the vessels to radiation. It was assumed that serotonin incorporated in blood platelets was significant in vascular resistance and this was confirmed by injecting blood platelets containing serotonin into irradiated animals. (H.L.W.)

25830 EFFECT OF X RADIATION ON DELAYED RESPONSES IN GUINEA PIGS. Bregadze, A. N.; Bregadze, M. A. (Inst. of Physiology, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 65: No. 3, 681-4(Mar 1972). (In Russian).

Lethal doses of x rays caused impairment of short-term memory in guinea pigs only for 22 to 25 days from the movement of exposure. Memory was then restored almost to the original level. (auth)

25831 STUDIES ON THE COMBINED EFFECT OF RADIATION AND PYRIMIDINE ANALOG ON TRANSPLANTED TUMOR. Kamakazu, Kiyomaro (Showa Univ., Tokyo). Showa Igakkai Zasshi; 30: No. 12, 795-807(Dec 1970). (In Japanese).

The growing pattern of a transplanted solid tumor (Ehrlich ascites tumor) was the indicator of radiation effects combined with pyrimidine analogues in this experiment. Intra-peritoneal injection of deoxybromouridine (BUdR) in the doses of 10 mol, 1 cc, or of 5-fluorouracil (FU) of 10 mol, 0.2 cc demonstrated the growth inhibitory effects on the tumor. The radiation effect was enhanced by BUdR or FU. From the results of the experiment based on the difference of effectiveness owing to the time interval of administration of radiation and the drugs, or vice versa, it appeared that BUdR was incorporated into DNA before irradiation. FU, on the other hand, seemed to inhibit the recovery process, which was to take place between the time of irradiation and appearance of the radiation injury. (auth) (Japan)

25832 CELL KINETIC STUDY ON THE EFFECTS OF X-IRRADIATION TO TONGUE EPITHELIUM OF RAT. Toda, Masatoshi (Tokyo Medical and Dental Univ.). Kokobyo Gakkai Zasshi; 38: No. 1, 159-71(Mar 1971). (In Japanese).

It was estimated that the cell generation time of the normal epithelium of the rat tongue was 62.6 hrs and the lengths of G1, S, G2, and M phases of the cell cycle were 52.4, 6.7, 2.2, and 13 hrs respectively. Effects of 500 and 1000 R x-ray doses on mitosis and pyknosis were observed with the aid of autoradiography of ^{3}H-TdR labeled cells. After four to ten hrs, a decrease was observed in the percentage of labeled mitoses. After six hrs, the maximum increase in pyknosis was observed. Results indicated that radiosensitivity was lowest during the S phase of the cell cycle. It was suggested that an analysis of radiation injury could be made in vivo using pyknosis as an index. (H.L.W.) (Japan)

25833 CORRELATION OF ERYTHROPOIESIS AND RETICULOENDOTHELIAL FUNCTION FOLLOWING IRRADIATION. Ito, Yasuhiko; Sato, Tachio; Takahashi, Kunibumi (Tohoku Univ., Sendai). Nippon Igaku Hoshasen Gakkai Zasshi; 31: No. 1, 44-9(Apr 1971). (In Japanese).

This experiment was designed to assess the correlation of erythropoiesis and reticuloendothelial function of bone marrow to irradiation. The left pelvis and leg of rabbits were subjected to 800 R, 1,600 R, 3,200 R and 5,000 R, respectively from a Telecobalt unit. The liver, spleen and marrow were subjected to radioassay and the marrow to marrow scanning. For radioassay, ^{59}Fe and ^{198}Au were administered prior to killing. The effect of irradiation upon the marrow was expressed as the ratio of decreased uptake of isotopes to the uptake in the unirradiated control. In another group of experiments, bone marrow scanning with ^{198}Au or ^{113m}In colloids was performed, in which the density of the scan and ratemeter tracings were used for the evaluation of the radiation effects. It was concluded from the above experiments that: the iron uptake by the erythron is remarkably suppressed according to the dose; the degree of suppression of ^{198}Au uptake by RE cells was slight, compared to the iron uptake of erythron, regardless of dose. However, bone marrow scanning with radioactive colloid could delineate a slight inhibition of the RE function. (auth) (Japan)

25834 STUDIES ON THE IRRADIATION EFFECTS ON NORMAL ORGANS: THE EFFECTS OF IRRADIATION ON THE STRUCTURE OF FINE VASCULATURE IN THE LUNG OF MICE. Mano, Hirofumi (Tokushima Univ., Japan). Shikoku Igaku Zasshi; 27: No. 2, 305-12(Apr 1971). (In Japanese).

The effects of whole body irradiation on the structure of fine vasculature in the lung of mice were investigated utilizing the India-ink method with respect to successive changes after single and fractionated irradiations. Based on the microangiogram of fine vasculature in the lung, the normal structure of vasculature

in the alveolar wall is composed of the network of capillaries of about 10μ in diameter. When a single irradiation of ^{60}Co γ-rays with 1000 R (50 R/min) was applied to the whole body, microangiograms were examined before irradiation and 3 hours and 1 and 3 days after irradiation. Partial narrowings of the diameter of capillaries, exudation from the capillaries and irregular networks of capillaries were observed from immediately to 3 hours after irradiation in the vasculature of alveolar walls. Greater changes were brought about 1 and 3 days after irradiation than in earlier stages. Especially, the dilatation of capillaries was remarkable 3 days after irradiation. A low dose rate (5 R/min) induced smaller changes in the fine vasculature of the lung than a high dose rate (50 R/min) irradiation. To know the effects of fractionated irradiation on the fine vasculature, a total dose of 1200 R was given in 6 and 12 splits during 2 weeks. From microangiograms examined 1 and 2 weeks after the beginning of irradiation, it was found that increases in number of fractionated irradiation caused decreases in the grade of injuries of the capillaries. (auth) (Japan)

25835 LEUKEMOGENIC ACTIVITY OF X RAYS IN MICE OF SWISS STOCK. Chamorro, A. (Inst. of Radium, Paris). Experientia; 28: No. 1, 73-4(15 Jan 1972). (In French).

A total dose of 200 R of x rays was administered in four fractions at intervals of 8 days to a pure strain of mice aged three to four months. A table is presented to show the percentage of general lymphoma, lymphoma of the thymus, and leukemia that developed in irradiated and control mice. A high percentage of lymphomas and leukemia was induced by x radiation; these results do not agree with observations made in other strains of mice. (H.L.W.)

25836 INHIBITION OF HEMATOPOIESIS AND FORMATION OF OSTEOBLASTS IN THE BONE MARROW OF LETHALLY IRRADIATED MICE AFTER TRANSPLANTATION OF ALLOGENIC LYMPHOCYTES. Shvets, V. N.; Man'ko, V. M. (Inst. of Biophysics, Moscow). Byull. Eksp. Biol. Med.; 72: No. 12, 84-7(Dec 1971). (In Russian).

The influence of transplanted lymphocytes of CBA mice on the formation of osteoblasts and hematopoiesis in the bone marrow of lethally irradiated hybrids F_1(CBA × C57BL) was studied. Seven to nine days after transplantation of cells in the femoral bone of recipients an inactivation of the process of formation of osteoblasts and foci of hematopoiesis was recorded. A conclusion is made that lymphocytes are endowed with a wide spectrum of effects on dividing nonsyngeneic cells in different areas of the hematopoietic system. Colony-forming cells and precursors of antibody-producers in the spleen, osteoblasts and foci of hematopoiesis in the bone marrow of irradiated recipients, are subjected to inactivation. (auth)

25837 RADIATION-INDUCED INTESTINAL DAMAGE AND THE SECOND CORTICOSTEROID INCREASE. Poulakos, L. (Univ. of Iowa, Iowa City); Osborne, J. W.; Flemming, K.; Geierhaas B. Int. J. Radiat. Biol.; 21: No. 2, 153-7(Feb 1972).

The magnitude of the "second corticosteroid increase" was determined in x-irradiated rats. Exposures of only the intestine initiated and sustained an increase in plasma corticosteroids from 1–5 days after 1000 R. At 3 days after irradiation, adrenal and plasma levels were dose-dependent. Resection before whole-body x-irradiation, regardless of size of resection or time between resection and irradiation, did not modify corticosteroid responses unless 80 percent of the small intestine was removed. (auth) (UK)

25838 PHYSICAL ENERGY TRANSFER AND BIOLOGICAL EFFECT. Tobias, Cornelius A. (Univ. of California, Berkeley). pp 28-50 of Advances in Medical Physics. /Laughlin, John S. (ed.). Boston; Second International Conference on Medical Physics, Inc. (1971).

From second international conference on medical physics; Boston Mass. (11 Aug 1969).

Correlations between physical energy transfer and cellular biological effect following exposure to charged particles with varying LET are presented. A sequence of biological, chemical, and physical events is outlined that might take place when radiation acts on living cells. Emphasis is placed on pathways of biological effects on cells. When survival, chromosome aberrations, or mutations are the end effects studied, the experimental evidence points strongly to the high radiovulnerability of DNA in the cell nucleus. The effect on ribosomal and messenger RNA is present, but less important, since these molecules can be resynthesized with intact structure if intact DNA is present. Protein effects are important only as co-factors to nucleic acid damage; for example, when nucleoprotein and nucleic acids crosslink, specific protein enzymes are necessary for breakdown and repair. Thus, DNA injury, breakdown, and subsequent rejoining and repair are salient features of the action of radiations on cells. Radiation also has profound effects on cell membranes and, in special systems, injury to these can be a determinant to subsequent biological events. Reactions involved in radioinduced injuries of nucleic acids in vivo or in vitro, the various types of lesions, which lesions lead to specific biological effects, and which are modified by repair processes are discussed. It is pointed out that DNA lesions of sufficient stability for experimental study have been identified as base alteration, base-to-base interaction, single chain scission, double chain scission, cross-link, and protein-DNA link. It is sometimes assumed that all of these effects, except double chain scission, appear to be repairable by various degrees though this has not been shown with reliability for each type of lesion in a wide variety of cells. A model for successive stages in developing cellular lesions that lead to survival, survival with mutation, or lethality is presented that includes the action of chemical and physical modifiers of radiation effects and changes in radiation sensitivity in different stages of the cell division cycle. An attempt was made to simplify the description of the process by averaging parameters for many physiological states. (C.H.)

25839 PROTECTION AGAINST THE SECONDARY SYNDROME OF IRRADIATED MICE BY IMMUNE SERUMS. Voisin, J. E.; Kinsky, R. G.; Voisin, G. A. (Hopital Saint-Antoine, Paris). Compt. Rend., Ser. D; 273: No. 22, 2180-2(29 Nov 1971). (In French).

One hundred and twnety-four A/JAX mice received lethal doses of radiation and were restored using the bone marrow of C 57Ks mice. They were simultaneously given doses of normal and immune C 57Ks serum (possessing antibodies facilitating the A/JAX grafting for mice receiving C 57Ks). Animals of the second group were significantly protected against the secondary syndrome resulting from the graft-host type reaction of the injected allogenic cells. (France)

25840 DISRUPTION OF IRRADIATED GASTROINTESTINAL TRACTS, EXPERIMENTAL, AND CLINICAL STUDY. Kunisaki, Tadahiko (Kurume Univ., Fukuoka). Nippon Shokakibyo Gakkai Zasshi; 68: No. 7, 670-83(Jul 1971). (In Japanese).

The morphological and functional aspects of the disruption of biological functions in irradiated gastro-intestinal tracts were studied. When mice and rats were examined after irradiating them with x-rays in concentrations of about LD_{50}, the villi become flatter and lower because the growth of new cells decreased in the intestine as nuclear division in the crypts proceeded. The disruption of the mucous membrane was greatest after 2 or 3 days but it gradually disappeared in the animals who survived. When the movement and absorption of the intestinal tracts were investigated using ^{57}Co-B_{12}, the passage of the stomach contents was impeded and peristalsis of the small intestine decreased after irradiation. After 48 hours the absorption, which had been practically maintained until then, dropped markedly. When the gynecological patients who were having deep treatment of the pelvis were investigated, disruptions, though slight, were evident in the elimination of intravenously injected ^{131}I-polyvinylpyrolidone (PVP) into the intestinal tracts and in the absorption of ^{131}I-triolein, D-xylose and B_{12}. (Japan)

25841 RADIATION DOSE DISTRIBUTION IN THE BEAGLE DURING RADIOGRAPHIC EXPOSURE. Barnes, J. E.; Osborn, L. A. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Contract AT(29-2)-1013. Amer. J. Vet. Res.; 33: No. 1, 131-6(Jan 1972).

Radiation dose distribution was studied in the radiographically exposed beagle dog, using thermoluminescent dosimetry. Results in three frozen dog cadavers were compared with those in a dog phantom. Depth-dose curves, isodose patterns, midline exposure dose, and doses to selected tissues from a standard radiographic survey consisting of 11 exposures were determined. The maximal midline exposure dose measured for the cadaver was less than 70 mR for the complete radiographic survey. Agreement between results in the phantom and in the cadavers was good, except in the cervical spine area. (auth)

25842 EFFECTS OF ^{60}Co RADIATION ON THE CELLULAR RESPONSES IN DEGENERATING DORSAL COLUMNS IN THE RAT SPINAL CORD. Cavanagh, J. B.; Hopewell, J. W.; Chen, F. C. K. (Inst. of Neurology, London. St. Mary's Hospital Medical School, London). Acta Neuropathol.; 19: No. 4, 318-22(1971).

Rats were γ irradiated with doses of 1000 to 3000 rads to the cervical spinal cord and subsequently given a paralytic dose of p-Bromophenylacetylurea. The nuclear populations in the degenerating dorsal columns were determined and it was found that a significant suppression of cell proliferation occurred after all three dose levels. The cell populations in the shielded parts of the tracts rostral to the irradiated zone were not affected. (auth)

25843 ENZYME HISTOCHEMICAL AND HISTOLOGICAL CHANGES IN THE MYOCARDIUM FOLLOWING EXPERIMENTAL TELECOBALT IRRADIATION. Kunde, D.; Kranz, D. (Humboldt-Univ., Berlin). Exp. Pathol.; 6: No. 2, 21-6(1972). (In German).

Cardiac lesions following irradiation of rabbits were investigated. Pathogenesis, appearances and localization of early changes in the myocardium following γ irradiation were studied by enzyme histochemistry. (auth)

25844 ASCITIC TUMOR PRODUCED BY BHK-21 CELLS (CLONE 13) IN HAMSTERS EXPOSED TO WHOLE-BODY X IRRADIATION. Mayo, J. (Comision Nacional de Energia Atomica, Buenos Aires); Moreira, J. L.; Lombardo, J. H.; Conti, C. J.; Rivenson, S. Arch. Exp. Veterinaermed.; 25: No. 5, 853-62(1971). (In German).

Subcutaneous or intraperitoneal inoculation of BHK-21 cells (clone 13) into hamsters produces a compact tumor. The aim of the present experiments was to produce an ascitic tumor in order to obtain free cells in a fluid medium, similar to a cell culture. For this purpose the immunosuppressive effect of x-rays on animals exposed to whole-body radiation was utilized, together with simultaneous cell selection by means of serial passage of inoculated cells. Hamsters irradiated with 700 R of x-rays were given intraperitoneally 5×10^6 BHK-21 cells from monolayer cultures. In this way it was possible to obtain free cells from the abdominal cavity, starting with the first passage. These multiplied upon successive passages. After the third passage, the cells formed ascitic tumors in normal animals, with average cell concentrations of 8×10^7 per ml. Since BHK-21 cells are susceptible to foot and mouth disease virus, this form of cell production is suggested as a source of virus. (auth)

25845 PATHOGENESIS OF RADIATION HEMORRHAGE. Oyvin, I. A.; Volodin, V. M.; Oyvin, V. I.; Tokarev, O. Yu. (Instituts fuer Medizinische Radiologie, Obninsk, USSR). Radiobiol.-Radiother.; 12: No. 1, 53-61(Jan 1971). (In German).

Following whole-body gamma irradiation of rabbits, as well as local gamma and x irradiation of the skin, a liquefaction of the matrix of connective tissue, due to a depolymerization of mucopolysaccharides, was observed; a late effect was a decreased mechanical stability of the blood vessels. No relationship was found between vascular resistance and the state of mucopolysaccharides. Examinations of humans, rabbits, guinea pigs, and rats showed that depolymerization of mucopolysaccharides caused by hyaluronidase did not affect the mechanical stability of the blood vessels. Results indicated that the increased hemorrhage in radiation sickness could not be explained entirely by thrombocytopenia or by functional changes in the thrombocytes. Possible causes of the hemorrhagic syndrome in radiation sickness are discussed. (H.L.W.)

25846 EFFECT OF SOME DIPHENYLCARBINOL DERIVATIVES ON HEMATOPOIESIS IN IRRADIATED AND INTACT ANIMALS. Izmozherova, E. L.; Grayfer, A. L.; Kholodenko, D. R. Izv. Estestvennonauch. Inst. Perm. Gos. Univ.; 14: No. 10, 127-42 (1970). (In Russian).

Experiments involving intraperitoneal injection of irradiated rats with diphenylcarbinol (I) derivatives containing one to three radicals showed that the radioprotective effect (bone marrow hematopoiesis) was highest when three radicals of $N(CH_3)$ were present in the I molecule. (JPRS)

25847 RECONSTITUTION OF THE T-CELL POOL AFTER IRRADIATION OF MICE. Doenhoff, M. J.; Davies, A. J. S. (Royal Cancer Hospital, London). Cell. Immunol.; 2: No. 1, 82-90(Feb 1971).

The pool of circulating thymus-derived (T) cells was investigated by the use of chromosome marker techniques on lymphocytes from irradiated mice responding by mitosis to PHA in vitro. In thymectomized irradiated mice immediate or late implantation of a thymus graft can restore an irradiation-depleted T-cell pool. The contribution made by cells native to the thymus graft to the reconstituted pool is inversely proportional to the time between irradiation and implantation of the thymus graft. In heavily irradiated animals with an intact thymus it appears that many of the T cells in the circulating pool of PHA-responsive cells can derive from the host thymus for the first fifty days after irradiation but thereafter the cells found were mainly from a therapeutically administered bone-marrow inoculum. When the number of bone-marrow cells injected was increased relatively fewer residual host cells were discovered. These findings are discussed both in relation to current theories of thymic function and the mechanisms of recovery of lymphocyte populations after irradiation. (auth)

25848 ROLE OF CYTOKINETICALLY RESTING CELLS FOR THE REGENERATION OF AN APLASTIC BONE MARROW. AUTORADIOGRAPHIC STUDIES ON RAT. Haas, Rainer J. (Univ., Ulm, Ger.). Aerztl. Forsch.; 25: No. 6, 185-94(10 Jun 1971). (In German).

By continuous administration of ^{3}H-thymidine (^{3}H-TdR) in utero and during neonatal life 4 to 5 weeks old 100% labeled animals were obtained. 4 to 5 weeks after discontinuation of ^{3}H-TdR application distinct classes of cytokinetically resting labeled bone marrow cells were detected. These animals received either x irradiation of the body with 750 R with one leg shielded or nitrogen mustard or hydroxyurea four times 6 hrs apart. In one of the experiments did the reticular and endothelial cells show indications of destruction or stimulation. Small bone marrow lymphocytes decreased however their labeling intensity before onset of regeneration. No change of labeling pattern of lymphocytes of other organs could be observed. During the beginning regeneration of the bone marrow a wave of labeled blast cells and subsequently differentiated myelocytic and erythrocytic cells was found. The behavior of labeled bone marrow lymphocytes during recovery from injury suggests that these cells play an important role in the regenerative process of the bone marrow. (auth)

25849 DISAGGREGATION OF POLYSOMES IN RAT THYMUS FOLLOWING WHOLE-BODY X IRRADIATION. Saroja, S.; Patil, M. S.; Sreenivasan, A. (Bhabha Atomic Research Centre, Trombay, India). Indian J. Biochem. Biophys.; 8: No. 4, 254-6(Dec 1971).

Polysomal profiles of the rat thymus examined at 18 and 48 hr following whole-body exposure to x-rays (600 R) exhibited shifts from heavier aggregates towards monosomes. These changes were accompanied by significant increase in alkaline ribonuclease (RNase) activity with concomitant decrease in alkaline RNase inhibitor levels. The results suggest that disaggregation of polysomes after irradiation may be the consequence of activation of alkaline RNase resulting from the fall in the levels of the inhibitor. (auth)

25850 TEMPLATE ACTIVITY OF LIVER CHROMATIN IN RATS FOLLOWING BODY EXPOSURE TO X IRRADIATION. Subba Rao, M. N.; Netrawali, M. S.; Pradhan, D. S.; Sreenivasan, A. (Bhabha Atomic Research Centre, Trombay, India). Indian J. Biochem. Biophys.; 8: No. 4, 257-62(Dec 1971).

Synthesis of RNA is stimulated in rat liver during 4 to 24 hr following whole-body exposure to 1000 R x-irradiation. At these time intervals, both Mg^{2+}-activated and $Mn^{2+}/(NH_4)_2SO_4$-activated reactions by isolated liver nuclei are enhanced. Template activity of isolated liver chromatin, as measured by exogenous liver RNA polymerase, was found to be significantly amplified during this post-irradiation period; at 18 hr, the activity is raised by about 50 to 60% above that in nonirradiated controls. These findings suggest that changes in transcriptive ability largely contribute to the stimulus in RNA synthesis and, in turn, protein synthesis in liver. (auth)

25851 ANALYSIS OF THE MECHANISMS OF AMINAZINE ACTION ON THE HIGHER DIVISIONS OF THE CNS USING AN EXPERIMENTAL MODEL OF CEREBRAL PATHOLOGY. Airapetyants, M. G.; D'yakova, S. D.; Chubukova, K. I. (Inst. of Higher Nervous Activity and Neurophysiology, Moscow). Zh. Vyssh. Nerv. Deyateln. im. I. P. Pavlova; 21: No. 1, 169-75(1971). (In Russian).

Effects of x radiation on the brain of dogs were studied following prenatal exposure; disturbances in the cerebral cortex and in subcortical structures were observed in relation to the time of treatment. Such animals served as experimental models for brain pathology for studying the mechanisms of effects of neurotropic drugs. Reactions to chlorpromazine appeared sooner and were more pronounced in animals with predominantly subcortical disturbances. This indicated that chlorpromazine acted primarily on the subcortical structures. (H.L.W.)

25852 X-RAY INDUCED FRAGMENTATION OF THE ORGANIZER OF A LAMPBRUSH CHROMOSOME DIFFERENTIATION IN PLEURODELES WALTLII. Lacroix, J. C.; Loones, M. T. (Univ., Paris). Chromosoma; 36: 112-18(1971). (In French).

X rays have been used to induce heritable changes in the specific morphology of the lampbrush chromosomes in the newt Pleurodeles waltlii. The karyotype organization of female progeny of irradiated males was studied. Nine out of ten females were found to have chromosomal aberrations. In one of the nine, one of the breaks occurred at the sphere organizer, the sphere being part of the striking morphological features of chromosome IV. On irradiation the normal sphere organizer had been broken into two fragments each of which, when recombined with other chromosome breaks, still forms a sphere. The relationship of these observations to genome redundancy is discussed. (auth)

25853 EFFECT OF OXAPHENAMIDE ON THE INTENSITY OF CHOLERESIS AND SYNTHESIS OF BILE ACIDS IN EXPERI-

MENTAL RADIATION SICKNESS. Drogovoz, S. M. Farmakol. Toksikol.; 35: No. 1, 37-40(Jan-Feb 1972). (In Russian).

Tests conducted on 114 albino male-rats brought evidence that in acute radiation sickness the degree and duration of choleretic action exerted by oxaphenamine in doses of 25 and 50 mg per 100 g of the body weight abruptly decreased, particularly when large doses of the drug were used. The nature of its action on the formation of cholates in irradiated animals depended upon the dosage of the compound and the period of radiation sickness. The diminution of the total amount of cholates passed together with the bile under the effect of oxaphenamide 1 and 4 weeks after irradiation was due to a reduced content of tauro-, glyco- and desoxycholic acids. In acute radiation sickness oxaphenamide, apparently, inhibits the synthesis of desoxycholic acid from cholesterol, and in the late stage of the disease it also hampers the formation of glycocholic acid from cholic acid and glycocol. (auth)

25854 EFFECT OF γ RADIATION ON THE STRUCTURE OF DNA AND THE DEOXYRIBONUCLEOPROTEIN ISOLATED FROM IRRADIATED LYMPHATIC GLANDS. Tyrawska-Spychalowa, D.; Grabowska, B.; Rozga, B.; Kaminska, A. (Univ. of Lodz, Poland). Biochim. Biophys. Acta; 254: No. 1, 40-7(Nov 1971).

Investigations on the effect of γ radiation on the limiting viscosity value of deoxyribonucleic acid and on the elasticity of the deoxyribonucleoprotein isolated from irradiated calf lymphatic glands are discussed. The results differ distinctly from those of similar experiments carried out on DNA and deoxyribonucleoprotein preparations irradiated after isolation from the tissues. The greater sensitivity to γ radiation of deoxyribonucleoprotein with a higher protein content may be noticed. The structural changes of DNA and the deoxyribonucleoprotein observed demonstrate the strong influence of even very small doses of ionizing radiation (approx. 1 krad), causing changes in the DNA–protein interaction and in the deoxyribonucleic acid itself. (auth)

25855 THERAPEUTIC EFFECT IN LETHALLY IRRADIATED MICE OF CELL FRACTIONS OBTAINED BY GRADIENT CENTRIFUGATION OF SPLEEN HOMOGENATE IN BOVINE SERUM ALBUMIN. Petyrek, P.; Mraz, J. (Medical Research and Postgraduate Training Inst., Hradec Kralove, Czech). Folia Biol. (Prague); 18: No. 1, 36-41(1972).

A modified method of gradient centrifugation of spleen cells of non-inbred H-strain mice was employed for separating the fraction of hemopoietic stem cells. The effectiveness of the fraction was then tested in mice of the same strain exposed to a 900 R whole-body exposure of ^{60}Co γ rays. The therapeutic effect of the cell fraction applied was found to be markedly dependent upon the physical parameters of gradient centrifugation and upon the number of cells injected. With the optimum combination of both these factors, all treated mice survived the 30-day observation period following the irradiation. (auth)

25856 DEVELOPMENTAL EXPRESSION OF H-2 ANTIGENS IN THE SPERMATOGENIC CELL SERIES: POSSIBLE BEARING ON HAPLOID GENE ACTION. Vojtiskova, Marta; Pokorna, Zora (Inst. of Experimental Biology and Genetics, Prague). Folia Biol. (Prague); 18: No. 1, 1-9(1972).

The presence of H-2 antigens on diploid cell precursors of mouse spermatozoa was demonstrated by two serological techniques: inhibition of hemagglutination and indirect immunofluorescence. Absorption of two different hemagglutinating reagents was carried out using juvenile testes which contained only the less mature members of the spermatogenic cell series: spermatogonia and primary spermatocytes. For indirect immunofluorescence, paraffin sections were prepared from both juvenile testes and adult testes in the course of their postirradiation damage and recovery (following a local exposure to 6,000 R x-rays). The results are discussed from the viewpoint of their bearing on the problem of detection of the potential haploid gene action. Three mechanisms are theoretically considered through which the membrane of the spermatozoa could retain, at least to some extent, the H-2 phenotype of the diploid cell precursors; if so, the potential haploid gene action might be hardly discernible in the resulting mixed phenotype. (auth)

25857 COMBINED LETHAL EFFECTS OF LUCANTHONE (MIRACIL D) AND TOTAL-BODY IRRADIATION IN MICE. Bases, Robert (Albert Einstein Coll. of Medicine, New York). Radiology; 102: No. 1, 193-4(Jan 1972).

Sublethal doses of lucanthone (Miracil D) induced substantial mortality when administered to sublethally irradiated mice. Actinomycin D and lucanthone share many properties. Lucanthone's possible role as an adjuvant in clinical radiotherapy deserves consideration, especially in view of its wide use as a safe antiparasitic agent in man. (auth)

25858 NONCYTOKINETIC RADIATION INJURY: ANTICOAGULANTS AS RADIOPROTECTIVE AGENTS IN EXPERIMENTAL RADIATION HEPATITIS. Kinzie, J.; Studer, Rebecca K.; Perez, Blanca; Potchen, E. James (Washington Univ., St. Louis. Jewish Hospital, St. Louis). Science; 175: No. 4029, 1481-3 (31 Mar 1972).

Rats that were x irradiated with a single dose of 1500 R directed to the liver showed the following abnormalities: increased clearance of colloidal gold by the liver at 30 days, a decreased albumin space index at 30 days, and increased alkaline phosphatase at 60 days. In each of these cases, animals receiving Depo-heparin in dose ranges reasonable for human application had essentially normal values. There was no radioprotective effect with salicylates at the doses used. Higher doses of salicylates resulted in death of the animals. (auth)

25859 MORPHOLOGICAL CHANGES IN RABBIT BRAIN AFTER FRACTIONAL IRRADIATION OF THE HEAD BY FAST ELECTRONS. Kurkovskii, V. P.; Smirnov, R. V. (Polenov Research Neuro-Surgical Inst., Leningrad). Arkh. Anat., Gistol. Embriol.; 62: No. 3, 58-65(Mar 1972). (In Russian).

Morphological changes of cerebral tissue were studied in seven adult rabbits after fractional irradiation by electrons of 20 MeV from betatron B-4E. The animals were exposed to everyday irradiation with dose of 400 rad. The power of the dose in the beam of rays was 100 rad/min at the depth of electron equilibrium. The total dosage was from 5200 to 15,200 rad during the period 25 to 74 days. All the rabbits stood the irradiation well except two animals which were killed a month later due to their condition becoming worse after irradiation with the electrons in the dosage of 600 and 12,800 rad. The other five animals were killed within 5 to 7 months (total dosage 5200, 6400, 6800, 14,900 and 15,200 rad.). The preparations were stained after Nissl, Malory and with haematoxylin-eosin. The portions of the brain through which the beam of electrons passed were cut into complete series of sections, each 20th section being stained. In rabbits killed within a month after irradiation there appeared infiltrative—inflammatory lesions in the meninges and brain matter. The infiltrations consisted of polyblasts with the admixture of plasmic cells. In animals killed within five or more months there were three kinds of lesions: hemorrhages, degenerative dystrophic changes in the parenchyma and stroma, and progressive reaction of neuroglial units. In two rabbits degenerative dystrophic lesions reached a degree of necrosis predominantly in the white matter (doses: 14,900 and 15,200 rad). Around these necroses a pronounced gliomesodermal response was observed. (auth)

25860 AUTORADIOGRAPHIC STUDIES OF INTRAMEDULLARY SCHWANN CELLS IN IRRADIATED SPINAL CORDS OF IMMATURE RATS. Gilmore, Shirley Ann (Univ. of Arkansas, Little Rock). Anat. Rec.; 171: 517-27(1971).

The presence of intramedullary Schwann cells in spinal cords of rats x irradiated (total dose 4,000 R delivered at 722 R/min) when three days old and examined 15 or more days later was noted. An autoradiographic evaluation was made of spinal cords from groups of rats receiving a single injection of tritiated thymidine at an interval from 7 to 15 days after irradiation (3 days of age) and killed four hours to seven days following injection. The earliest post-irradiation interval at which the intramedullary Schwann cells were present was at nine days in only one animal. These cells were seen in approximately half of the rats injected and killed 11 days after irradiation and in all in the 15-day-group. In all of these cases the animals were killed four hours after injection of tritiated thymidine and a portion of this cell population was labeled. When the time between injection and autopsy was delayed for three or seven days, a decrease in intensity of the labeling was apparent and many cells were lightly labeled, indicating that cell proliferation had occurred. Although the evidence was not conclusive, the results suggested that the intramedullary Schwann cells were probably progeny of cells derived from the dorsal roots, the latter cells having been stimulated to migrate into and to divide within the spinal cord. (C.H.)

25861 EFFECTS OF X IRRADIATION ON LENS REGENERATION IN ADULT TRITURUS VIRIDESCENS. Donaldson, Donald J. (Univ. of Tennessee, Memphis). Anat. Rec.; 172: No. 1, 45-55 (Jan 1972).

Lens regeneration was inhibited in adult salamanders (Triturus v.) with 1500 R of x irradiation. Implants of irradiated or unirradiated segments of dorsal iris were then implanted into either irradiated or unirradiated eyes. When irradiated eyes received irradiated implants, only minor degrees of lens regeneration were seen from host and implant. Unirradiated eyes receiving unirradiated implants often formed two normal lenses, one from the host and one from the implant. Irradiated eyes receiving unirradiated implants usually formed one normal regenerate arising from the implant. Unirradiated eyes receiving irradiated implants usually formed only one normal regenerate, originating from the host. The results indicate that inhibition of lens regen-

eration by x irradiation is due to effects solely on the iris, and that unirradiated neural retina, under the experimental conditions used, does not stimulate recovery of the regenerative ability of an irradiated iris. These results are discussed in relation to the question of neural-tissue-mediated recovery of regeneration systems from x irradiation. (auth)

25862 USE OF A SUSTAINED, CONSTANT INFUSION TECHNIQUE FOR THE STUDY OF CORTISOL METABOLISM IN DOGS SUBJECTED TO WHOLE-BODY IRRADIATION. Graham, Leslie Stephen. Los Angeles; Univ. of California (1971). 253p. University Microfilms Order No. 72-2819.

Thesis.

Implants of Silastic tubing were used to give a sustained and constant release of tracer amounts of ^{14}C and ^{3}H labeled metabolite as markers for the continuous monitoring of production rates (PR) and metabolic clearance rates (MCR) of cortisol in normal dogs and following whole-body irradiation at doses of 150 to 300 rads. In the irradiated dogs there was a profound effect on cortisol metabolism, much greater than with ACTH or dexamethasone. Each animal exhibited a relative increase in peripheral plasma radioactivity levels and in the total amount of radioactivity excreted in the urine per day. (Diss. Abstr. int., B)

25863 MORPHOLOGICAL AND HISTOCHEMICAL STUDY OF THE EFFECTS OF X IRRADIATION ON THE SPINAL CORDS OF NEONATAL RATS. Beal, John Anthony Jr. Cincinnati; Univ. of Cincinnati (1971). 127p. University Microfilms Order No. 72-4339.

Thesis.

The metabolic relationship between neurons and glia in the neonatal central nervous system, when the glia are considerably reduced in number by x irradiation, was investigated. The caudal half of the spinal cords of 130 Sprague–Dawley rats at three days of age, were subjected to 2160 rads of x irradiation. Littermate animals served as controls. A variety of morphological and histochemical techniques were utilized on the lumbosacral spinal cord tissue from animals sacrificed at varying times up to 68 days post-irradiation. Morphological studies revealed that a considerable number of oligodendroglia were destroyed in the irradiated animals by three days post-irradiation, and that the proliferation of the surviving glia, as well as myelination, were inhibited. No neuronal damage or hemorrhage, however, were observed. By 35 days post-irradiation, there appeared to be a cephalocaudal progression of glial proliferation and myelination within the lower thoracic segments of the irradiated area. By 50 days post-irradiation the accumulation of glia and myelin had progressed into the upper lumbar segments, but at 68 days post-irradiation little further progression was noted. The lower lumbar and sacral segments, which remained unmyelinated showed signs of edema by 68 days post-irradiation. A glial migration from the cephalic area of the cord into the irradiated area was postulated and conditioned by both time and tissue dependent variables. Schwann cell invasion, accompanied by peripheral myelin formation within the spinal cord, was first noted at 25 days post-irradiation at the dorsal aspect of the cord. In later periods the cells were seen to invade the grey matter of the cord. The possible origin of such cells was discussed. The glia of the white matter in both control and irradiated animals at four days post-partum revealed no enzyme activity for succinic dehydrogenase, DPN diaphorase, or lactic dehydrogenase, G-6-P dehydrogenase, however, did show activity in a considerable number of glia. In the control animals at 18 days post-partum, a considerable number of glia showed activity for all enzymes studied. At 10 days post-irradiation, abnormal glycogen granules were observed within the grey matter neuropil of the irradiated animals. The granules had disappeared by 15 days post-irradiation, and none were observed in control animals. Several causes for the disruption of normal glucose metabolism are discussed. (Diss. Abstr. Int., B)

25864 EFFECT OF RADIATION ON PULMONARY BACTERICIDAL FUNCTION. Hahn, Fletcher Frederick. Davis, Calif.; Univ. of California (1971). 104p. University Microfilms Order No. 72-3578.

Thesis.

A set of experiments was designed to examine the effect of x irradiation on pulmonary bactericidal activity. Mice were irradiated with 500 R to the whole body and exposed to aerosols of ^{32}P labeled Staphylococcus aureus at 3, 10, 14, 21, and 31 days past irradiation. In a second set of experiments, mice were irradiated with 500 R to the thorax only and exposed with a similar regimen. Electron microscopic studies of macrophages washed from the lung, the number of macrophages washed from the lungs, histologic studies of lung sections, and routine hemograms were also performed. The effect of whole body irradiation was delayed and transient. The initial decrease in pulmonary bactericidal activity occurred 14 days and the maximal decrease occurred 21 days after irradiation. Bactericidal function was not impaired 3, 10 and 31 days after irradiation. The pulmonary bactericidal activity of the thoracic irradiated mice was not consistent in its response. The values were significantly higher than those of the whole-body irradiated animals 21 days after irradiation, however, indicating that shielding of the bone marrow protects against the effect of irradiation. According to these data, whole body irradiation transiently depresses intrinsic pulmonary bactericidal activity two to three weeks after exposure and accounts, at least in part, for the enhanced susceptibility of irradiated animals to pulmonary infections. The hypothesis was advanced that radiation affects the precursor cells of alveolar macrophages which later results in a functionally deficient mature cell. (Diss. Abstr. Int., B)

25865 RESPONSE OF C_3H MOUSE GASTRIC MUCOSA EXPOSED TO LOCALIZED GAMMA IRRADIATION. Chen, Kuang Yao. Houston, Tex.; Univ. of Texas (1971). 195p. University Microfilms Order No. 72-4404.

Thesis.

Proliferation, migration, differentiation, and radiosensitivity, as well as repair and recovery of cell components of gastric mucosa of 6 to 8 weeks old male C_3H mice were investigated five minutes to one year after localized ^{137}Cs γ irradiation with various doses in conjunction with autoradiography using ^{3}H-TdR and in situ cloning techniques. Tissue sections were studied extensively under light microscopy. A preliminary attempt was made to use the electron microscope to identify cell species within a single colony in the study of differentiation after irradiation. The results demonstrated that the mucosal epithelium of the body of the stomach was in a constant renewal state; there was one, but only one, stem cell compartment at the neck of the gland. It supplied cells, through proliferation, migration, and differentiation, to form mucous cells and surface cells which moved outward (lumenward) until extruded into the gastric lumen. The doubling time of the normal proliferating cells at the neck region was of the order of 33 hours. The mean outward migration rate was 2.5 to 3 μ per hours. The mean transit time for the non-proliferating cells moving from the proliferating compartment to the gastric lumen was 50 hours. The actual minimal time to reach the tip of the gland was 23 hours. The radiosensitivity of the stem cells is described by a D_0 value of 137 (129 to 146) rads. The capability for repair of the sublethal damage was great, the value for D_q being 543 (580 to 600) rads. Repair of sublethal damage started within 5 minutes after irradiation; below 800 rads about 72% of sublethal damage was repaired within 24 hours. Sixty-five percent of total repair was accomplished in the first hour after 700 rads; repair after 8 hours contributed less than 0.1% of the total. Cellular repair and repopulation allowed the stem cells to maintain the mucosa in a steady state after 200 rads irradiation per day for 8 days. Intrinsic factor production was not sensitive to radiation damage. (Diss. Abstr. Int., B)

25866 DOSE RATE EFFECTS ON BONE MARROW CELLULARITY AFTER SIMULATED SOLAR FLARE IRRADIATION IN BEAGLES. West, Joe Earl. Davis, Calif.; Univ. of California (1971). 164p. University Microfilms Order No. 72-3612.

Thesis.

Young adult male Beagles were given bilateral ^{60}Co γ irradiation at a sublethal dose of 240R ± 6% (midline air dose). Radiation was administered either as a protracted, 24-hr low dose rate (LDR) exposure simulating a low intensity solar flare event, or as a reference high dose rate (HDR) 0.5-hr exposure. The dogs were studied for four months to test whether quantitative differences would occur in the response of the bone marrow cell renewal systems during the early phase of cellular degeneration and subsequent regeneration after comparable doses of low linear energy transfer radiation at different intensity. Total skeletal bone marrow cellularity was similar for the control and LDR-irradiated dogs; both sets of values were exceeded by that for HDR-irradiated dogs. Histopathologic assessment of hematopoietic tissues reflected major cellular regeneration and tissue repair, with evidence of some residual injury. (Diss. Abstr. Int., B)

25867 INHERITED VESICAL CALCULI IN MICE: A QUESTION OF RADIATION-INDUCED MUTATION. Gates, Olive; Chute, Rosanna N. (New England Deaconess Hospital, Boston). J. Urol.: 107: No. 4, 589-94(Apr 1972).

Vesical calculi appeared among 14% of F11 and F12 male descendants of an irradiated brother–sister pair of mice. This was found in less than 0.1 per cent of thousands of aged rats and thousands of mice of 9 strains, and judging from published reports this is representative of general experience. The forma-

tion of vesical calculi in mice as a result of an inherited radio-induced metabolic disorder which is related to abnormal deposition of calcium is considered. (C.H.)

25868 EFFECT OF RADIATION ON BONE. Furstman, Lawrence L. (Univ. of California, Los Angeles). J. Dent. Res.; 51: No. 2, 596-604(Mar-Apr 1972).

Rats subjected to 600 R total body x radiation were studied. Changes in the epiphyseal cartilage were examined from the morphologic and enzymatic aspects, and were correlated with changes in the marrow contents and underlying bone. Changes noted were specific for radiation damage and were not caused by nutritional deficiencies. (auth)

25869 LYMPHOID CELLS IN DELAYED HYPERSENSITIVITY. III. THE INFLUENCE OF X IRRADIATION ON PASSIVE TRANSFER AND ON IN VITRO PRODUCTION OF SOLUBLE MEDIATORS. Salvin, S. B.; Nishio, J. (Univ. of Pittsburgh). J. Exp. Med.; 135: No. 4, 985-96(1 Apr 1972).

X irradiation up to 480 R did not inhibit either adoptive transfer of delayed hypersensitivity or production in vitro of soluble mediators, such as migration-inhibitory factor (MIF) in antigen-sensitized guinea pigs. Above that dosage and as high as 3000 R, adoptive transfer was inhibited, but production of MIF was not. An increase in skin response occurred when an interval of 24 to 48 hr was allowed to elapse after intravenous transfer and before skin testing. Treatment of recipients with colchicine at the time of adoptive transfer inhibited the development of a skin reaction to specific antigen. (auth)

Invertebrates

25870 RELATIVE FREQUENCY OF INDUCED MUTATIONS RECOVERED FROM DROSOPHILA MELANOGASTER GAMETOGENIC STAGES IRRADIATED AT DIFFERENT DOSE RATES. Rinehart, Robert R.; Lee, William R. (San Diego State Coll., Calif. Louisiana State Univ., Baton Rouge). Mutat. Res.; 14: No. 3, 287-97(Mar 1972).

Inseminated Drosophila females were exposed to radiation doses of approximately 2000 or 4000 R at dose rates ranging from 8 to 240,000 R/h. The observed frequencies of sex-linked lethal mutations induced in spermatozoa and oogonia suggest that dose-rate effects were absent in spermatozoa over the whole range and in oogonia up to 3000 R/h. There was a consistent increase in oogonial mutation frequency from 3000 to 240,000 R/h. These results are discussed in relation to the well-established dose-rate effects observed in the mouse. (auth)

25871 STUDIES ON A RECOMBINATION-DEFICIENT MUTANT OF DROSOPHILA. II. RESPONSE TO X-RAYS AND ALKYLATING AGENTS. Watson, W. A. F. (Univ. of Aberdeen, Eng.). Mutat. Res.; 14: No. 3, 299-307(Mar 1972).

When mature sperm of the recombination-deficient mutant c3G of Drosophila melanogaster is treated with x-rays or the alkylating agents ethyl methanesulphonate and diepoxybutane, highly significant differences are found in the frequencies of recessive sex-linked lethals and translocations in the case of x-rays, and in lethals only in the case of alkylating agents. It is shown that this difference occurs in the response of mutant and wild-type sperm treated in the heterozygous male, eliminating any possibility that background genetic differences in the mutant and wild-type strains were responsible for the results. It is suggested that an initial stage in the repair process is reduced or missing in the mutant and that the results provide further evidence of a connection between recombination and repair in higher organisms. The chemical results also suggest that the formation of point mutations and chromosome aberrations arise from different events as the latter do not differ in frequency in the mutant although the lethals do so considerably. (auth)

25872 KINETICS OF X-RAY-INDUCED SOMATIC CROSSING-OVER IN DROSOPHILA MELANOGASTER AND THE EFFECTS OF DOSE FRACTIONATION. Merriam, J. R.; Fyffe, W. E. (Univ. of California, Los Angeles). Mutat. Res.; 14: No. 3, 309-14(Mar 1972).

Nonlinear dose-response curves have been obtained with the x-ray induction of somatic crossover spots on Drosophila tergites, possibly reflecting the formation of independent breaks in two homologous chromatids in G_2 with restitution by crossing-over. Interrupting the irradiation dose for some time reduces the number of crossover spots observed compared with that found on flies irradiated continuously with the same total energy. The effect of dose fractionation is to separate the two breaks in time so that the pair of ends at the first break in the chromatid are rejoined to their original configuration before a new pair of ends is available for interaction. The amount of repair observed with 10 min separation is comparable to that observed from stage-7 oocytes. (auth)

25873 RADIORESISTANCE AND LONGEVITY OF INBRED LINES OF DROSOPHILA MELANOGASTER. Westerman, Jane M.; Parsons, P. A. (La Trobe Univ., Bundoora, Australia). Int. J. Radiat. Biol.; 21: No. 2, 145-52(Feb 1972).

The association between longevity and resistance to ^{60}Co γ-rays was examined in four inbred lines of Drosophila melanogaster. Regressions of mean mortality on dose fit both linear and exponential curves. The conclusion from both types of curve was that the resistance, as measured by the slope of the regression, varied between lines and was independent of the longevity of unirradiated flies. Although there was no difference in mean mortality between the two sexes within lines, the two sexes did differ, since the female variance was over twice that of the male variance. (auth) (UK)

25874 STERILIZATION OF PAEDOGENETIC HETEROPEZA LARVAE WITH X-RAYS. Went, D. F.; Wuergler, F. E. (Swiss Federal Inst. of Tech., Zurich). Experientia; 28: No. 1, 100-1 (15 Jan 1972).

Paedogenetic larvae of the gall midge were x-irradiated in order to obtain large numbers of sterile larvae with large fat bodies and a maximum amount of hemolymph. It was found that the reduction in the number of offspring per larva compared to controls depended on the dose and age of the larva at the time of irradiation. The stages between blastoderm and germ band retraction were found to be the most radiosensitive. When unhatched larvae were irradiated, larger doses were needed for sterilization as compared to 48 hr old larvae. Histolysis of nearly all larval organs occurred in aged sterile larvae. (H.L.W.)

25875 STUDIES ON THE REPRODUCTIVE BIOLOGY OF THE MIGRATORY GRASSHOPPER MELANOPLUS SANGUINIPES (FABRICIUS) (ORTHOPTERA : ACRIDIDAE) WITH PARTICULAR REFERENCE TO THE ROLE OF THE MALE. Pickford, Roy. Saskatoon, Saskatchewan; Univ. of Saskatchewan (1971). 169p. University Microfilms Order No. 71-26,236.

Thesis.

This study deals with the reproductive biology of the migratory grasshopper, Melanoplus sanguinipes (Fabr.), with emphasis on the role of the male. During courtship the dominant role is assumed by the male. The prominent antennal manipulations and femoral vibrations, while forming an integral part of the behavioral pattern, do not appear essential for normal copulations. Visual stimuli proved to be of primary importance in "homing in" on the female prior to the mounting leap; blinding the male brought to a halt all courtship activities. The males were clearly able to differentiate between immature and mature females, and also between virgins and mated females; this was possibly accomplished by means of chemical stimuli emitted by the females. Observations on the copulatory behavior of individually marked grasshoppers throughout the adult stage indicated that sexual activity was often high with maximum couplings of 56 recorded for a male and 46 for a female. In addition, multiple daily couplings, to a maximum of five, were common. The copulatory period averaged about 45 min and reached a maximum of 195 min. Mating did not appear to occur at random with significant preferences shown by certain males for certain females. The total number of couplings by all males with their three most preferred females was 139 compared to 13 with the three least preferred females. The majority of couplings occurred during the morning; a similar situation took place in the field except that unfavorable weather restricted sexual activity. Insemination takes place by means of a small, non-cellular spermatophore which forms soon after coupling has occurred. The spermatophore is forced into the spermatheca for a short distance and the semen expelled. It is then retracted and ejected by the male. The entire process may take place in as little as 3 min. Up to 14 spermatophores may be produced during a single coupling. A gravid female, after testing the ground in search of a suitable oviposition site, takes about 45 min to complete egg deposition; this comprises about 20 min to dig the hole, about 7 min to deposit the eggs at the rate of one every 10 to 13 sec, and the remainder of the time to eject the frothy plug material and to finally cover the hole. While a moist site is usually preferred, it was shown that dry sand was unsuitable primarily because of the loose substrate. When an acceptable site is not available a female may withhold her eggs for several days and ultimately resorb them. Increased coupling activity consistently reduced female longevity. On the other hand, sustained copulation tended to stimulate egg deposition as well as to increase egg hatchability. Implantation experiments showed that the oviposition stimulus originated in secretions from the accessory glands of the male, primarily the short hyaline types. Optimum egg hatchability was dependent upon proper fertilization which in turn was

related to an adequate sperm supply in the female provided by sufficient mating activity. As sperm became depleted the percentage hatch and the proportion of males among the hatchlings declined; consequently eggs produced by parthenogenesis showed very low hatchability and produced only female hatchlings. In studies on adult sterility it was found that castration was effective provided the operation was performed prior to any movement of sperm into the seminal vesicles. Such sterile males effectively accelerated the oviposition rate; however, those with ejaculatory duct excised did not. This confirmed the responsibility of the accessory gland secretions of the male in the egg-laying stimulus. Exposures of adults to abnormally high or low temperatures caused death before sterilization. X radiation, while effective as a sterilizing agent, was generally detrimental to both males and females. Dosages of 500 rads or more resulted in reduced longevity, lower rates of oviposition, and reduced hatchability of the eggs. Sterility resulted from the destruction of reproductive cells and there was no evidence of dominant lethal mutations. It would therefore appear that the sterile male technique has little use as a method of biological control of this insect. (Diss. Abstr. Int., B)

25876 ACUTE LOW-LEVEL GAMMA RAY EFFECTS ON THE REPRODUCTION AND ADULT SURVIVAL OF RHYZOPERTHA DOMINICA (COLEOPTERA: BOSTRICHIDAE). Singh, Harpal (Knoxville Coll., Tenn.). J. Ga. Entomol. Soc.; 6: No. 4, 258-64(Oct 1971).

Three groups of one-week-old adults of Rhyzopertha dominica Fab. were exposed to 500, 1000, and 2000 R respectively to determine the effect of low-level gamma rays on the post exposure survival and fertility of adults. Irradiated adults produced normal and abnormal eggs. Acute low-level irradiation suppressed the production of normal eggs, delayed the onset of oviposition, and hurried the termination of oviposition significantly. Contrary to this, all three treatments increased the production of abnormal eggs and prolonged their period of production. Larvae from normal eggs died in 10 to 15 days following hatching. Postirradiation adult survival was shortened significantly with increasing irradiation doses. Practical and radiobiological implications of the findings are discussed. (auth)

25877 GENETIC VARIATION INDUCED BY RADIATION AND CHEMICAL AGENTS IN DROSOPHILA MELANOGASTER. Venkatasetty, Rangaswamy. Bowling Green, Ohio; Bowling Green State Univ. (1971). 138p. University Microfilms Order No. 72-5119.

Thesis.

Experiments were undertaken using late embryonic and young larvae of Drosophila melanogaster in order to determine the effects of ionizing and non-ionizing radiation, alkylating and non-alkylating agents, administered singly or in combination on the genetic material. Observations and analyses were made on overall mortality of the exposed individuals themselves and induction of primary nondisjunction leading to the gain or loss of the first and/or fourth pair of chromosomes, mutations at four specific loci in the two large autosomes, and crossing over between the fourth chromosomes. It was noticed that all the treated groups were characterized by a high mortality and sterility coupled with low fecundity. X rays and ultraviolet light given in combination increased the frequency of recombination and mutations; there was no evidence of any additivity. Caffeine administered after ultraviolet treatment produced more nondisjunction and crossing over than when given alone. Unexpectedly, while caffeine given after exposure to x rays increased the frequency of genetic variations, caffeine treatment following gamma ray exposure decreased the total genetic variation. Formaldehyde alone produced more genetic variation in males than females, while formaldehyde applied following x rays or ultraviolet did not increase the frequency of genetic variation. Cinnamaldehyde was shown to be a weak mutagen and tended to produce nondisjunction. Pretreatment with a sensitizing agent prior to uv exposure enhanced the frequencies of mutation and recombination, presumably by allowing better penetration of the incident light to the gonads. Chloroethylmethane sulfonate was found to be more effective in males than in females; it induced mutations and nondisjunction in frequencies comparable to that of formaldehyde and higher than that of caffeine or cinnamaldehyde. Exposure to x rays followed by uv and then caffeine decreased the total genetic variation. In all the treated and control series, it was found that the frequency of nondisjunction was lower for the fourth pair than for the first pair of chromosomes. It was shown that a variety of mutagenic agents either singly or in combination produced somatic as well as reproductive cell damage. The latter persists through growth and differentiation and are capable of being transmitted to future generations. (Diss. Abstr. Int., B)

25878 EFFECTS OF X RAYS ON THE FREE AMINO ACID CONCENTRATION OF THE HEMOLYMPH DURING THE LAST LARVAL INSTAR OF THE WAX MOTH, GALLERIA MELLONELLA (L.). Richardson, Barry Lovell. Columbus, Ohio; Ohio State Univ. (1971). 153p. University Microfilms Order No. 72-4621.

Thesis.

The radiosensitivity of the wax moth (Galleria mellonella) was studied during prepupal development as evidenced by changes in the hemolymph free amino acid pool. Last instar wax moth larvae were exposed to x rays in the 5 to 75 kR range and measurements of the hemolymph free amino acid pool were made at various times post-irradiation. The radiation-induced changes in this pool were correlated with radiation effects on the following entities: fat body amino acid content; silk production; weight loss; and pupation. (Diss. Abstr. Int., B)

25879 GENETIC ANATOMY AND FUNCTION OF THE 3A1-3C7 REGION OF THE X-CHROMOSOME OF DROSOPHILA MELANOGASTER. Kaufman, Thomas Charles. Austin, Tex.; Univ. of Texas (1970). 107p. University Microfilms Order No. 72-2362.

Thesis.

By means of a deficiency screening technique, 117 point mutations located in the 3A1-3C1 region of the salivary gland X-chromosome of Drosophila melanogaster were isolated. These mutations were induced by x rays, or by one of the following chemicals: ethyl methane sulfonate, ICR-170, ethylenimine, dimethyl sulfoxide, or nitrosoguanidine. The mutations were mapped by the use of overlapping deficiencies and duplications, by complementation analysis, and by recombination. The 117 mutations, all of which were lethals or semilethals, were distributed among 14 complementation groups or cistrons, as defined by the cis-trans test. There were a total of 16 cistrons in the 3A1-3C2 region, including the genes zeste and white. Generally, each of these cistrons could be assigned to a single specific band in this region of the salivary gland chromosome. (Diss. Abstr. Int., B)

25880 EFFECTS OF GAMMA RADIATION ON THE RESPIRATION OF ACARUS SIRO L. Hemenway, Robert Clark Jr. Athens, Ga.; Univ. of Georgia (1971). 69p. University Microfilms Order No. 72-2493.

Thesis.

The rate of oxygen uptake was determined for adult male and female, tritonymphal, and protonymphal stages of the grain mite, Acarus siro L., following exposure to γ radiation doses of 0, 5, 15, 25, 50, and 100 krad. Respiratory rates were checked at temperatures of 15 and 30 C. The results seem to indicate a higher rate of oxygen consumption following exposure to a dose of 25 krad. In mites tested at 15 C, significant stimulation of oxygen consumption was observed only at 25 krad. In mites tested at 30 C, significant depression in oxygen consumption was observed at 5, 50, and 100 krad. Oxygen consumption was examined per individual mite and as a function of body weight and body surface area. When individual mites were compared, females used the most oxygen, followed in descending order by males, tritonymphs, and protonymphs. Differences in oxygen consumption among life stages were less pronounced when comparisons were made on the basis of body weight. When comparisons were made on the basis of body surface area, the differences became even smaller with no significance at 15 C. All stages exhibited increased oxygen consumption when the temperature was increased from 15 to 30 C. However, the proportional increase in oxygen uptake in females was not as great as in other stages. (Diss. Abstr. Int., B)

Radionuclide Effects (Internal Source)

Refer also to abstracts 25594, 25596, 25886, 25897, 25898, 25901, and 25903.

Man

25881 CHANGES IN HEMODYNAMICS IN PATIENTS SUFFERING FROM TOXIC GOITER FOLLOWING TREATMENT WITH RADIOIODINE. Katsevman, A. E. Med. Radiol.; 16: No. 11, 36-40(Nov 1971). (In Russian).

A radiocardiographic study was made of hemodynamics in 24 patients suffering from thyrotoxicosis treated with ^{131}I. There was revealed a dependence between the state of hemodynamics and the results of therapy; normalization in euthyroidal condition, and increase in minute volume, tachycardia in residual phenomena of thyrotoxicosis, and hypocirculatory changes in development of hypothyroidism. (auth)

25882 CLINICAL PICTURE OF ^{137}Cs AND ^{134}Cs POISONING AT THE REMOTE PERIODS. Kirillov, S. A.; Vissonov, Yu. V. Med. Radiol.; 16: No. 11, 47-52(Nov 1971). (In Russian).

A mixture of ^{134}Cs and ^{137}Cs was administered to patients in 5

μc doses over a period of three yrs; the total dose was approximately 300 rad. Pathological changes were observed in the blood, nervous system, and liver. At the end of the three-yr period the ^{134}Cs content of the patient was 15 to 30 μCi and the ^{137}Cs content was 50 to 70 μCi. (H.L.W.)

Animals

Refer also to abstracts 25929–25933.

25883 DOSIMETRY OF INTERNALLY ADMINISTERED RADIONUCLIDES. Joint Meeting of the British Institute of Radiology and the Hospital Physicists Association. Part of the Proceedings of the British Institute of Radiology: Thirty-first Annual Congress, April 22 and 23, 1971. Brit. J. Radiol.; 44: No. 527, 906-8(Nov 1971).

Abstracts of the following papers are presented: General methods of evaluating absorbed dose (Trott, N.G); The acquisition and analysis of biological and human data (Taylor, D. M.; Saunders, M. G.); Microscopic dose distribution due to ^{125}I in the thyroid (Gillespie, F. C.; Orr, J. S.; Grieg, W. R.); Application of cavity theory to the dosimetry of bone-seeking radioisotopes (Burlin, T. E.; Snelling, R. J.): Dosimetry of ^{3}H and ^{14}C compounds. (Vennart, J.). (UK)

25884 OSSIFYING FIBROMA OF THE JAWS IN MICE AFTER INCORPORATION OF ^{224}Ra (THORIUM X). Luz, A.; Hindringer, B. (Gesellschaft fuer Strahlenforschung, Neuherberg, Ger.). Verh. Deut. Ges. Pathol.; 54: 450-4(1970). (In German).

During a long time experiment up to the death of NMRI-mice after incorporation of ^{224}Ra ossifying fibromas of the jaws were observed, frequently increased from a dose of 25 μCi/kg. The maximal incidence of these ossifying fibromas is 80%. These tumors show different morphological pictures with regard to the fibrous tissue and the type of ossification. In ossifying fibroma, alkaline phosphatase is limited to the active periost while in osteoblastic sarcoma this enzyme is evenly distributed in all parts of the tumor tissue. The jaw is, in the same dose range, also the main site of osteoblastic sarcoma. But the osteosarcomas appear usually in a shorter time interval after the incorporation than ossifying fibroma. Ossifying fibroma and osteosarcoma seem to be two different types of radiation induced tumors. (auth)

Microorganisms

25885 (COO-3423-1) LETHAL AND MUTAGENIC EFFECTS IN MICROORGANISMS GROWN IN $^{3}H_2O$. Progress Report, April 1, 1971–March 31, 1972. Person, Stanley; Snipes, Wallace (Pennsylvania State Univ., University Park. Dept. of Biophysics). Jan 1972. Contract AT(11-1)-3423. 2p. Dep. NTIS.

Progress is reported on studies of the lethal and mutagenic effects of tritium decays originating from thymine-$6H^3$, adenine-$2H^3$, adenine-$8H^3$, and guanine-$8H^3$ in Escherichia coli. The lethal and mutagenic effects for microorganisms grown one cell division or continuously in tritiated water and in the presence of tritiated nucleic acid precursors were determined. (C.H.)

25886 LETHAL EFFECTS OF ^{125}I DECAY BY ELECTRON CAPTURE IN ESCHERICHIA COLI AND IN BACTERIOPHAGE T1. Krisch, Robert E. (Argonne National Lab., Ill.). Int. J. Radiat. Biol.; 21: No. 2, 167-89(Feb 1972).

^{125}I was incorporated into the DNA of four strains of E. coli with differing repair capabilities and into coliphage T1, in the form of 5-iododeoxyuridine (IUDR). Lethal effects of the decay of incorporated ^{125}I were studied in these micro-organisms stored at −196°C. The lethal efficiency per decay under these conditions was 0.49 for T1 phage, 0.45 for E. coli B_{s-1}, and 0.38 for E. coli K−12 AB2463, both repair-deficient strains; but it was 0.22 for E. coli B/r and 0.15 for E. coli 15THU, which were capable of normal DNA repair. These lethal efficiencies were roughly an order of magnitude greater than those observed for ^{32}P decay in micro-organisms. According to approximate dose calculations, 5% of this killing in bacteria and 33% in T1 phage were accounted for by the external ionizing radiation emitted during ^{125}I decay. There was no evidence of substantial radiosensitization by the low degree of substitution of IUDR for thymidine in DNA. ^{125}I killing of T1 phage showed little or no host-cell reactivation and was nearly independent of storage temperature. It was suggested that these results were consistent with the hypothesis that the severe lethal effects of ^{125}I decay in the DNA of micro-organisms are largely due to direct physical disruption of the DNA molecule by the Auger effect, but that a significant role for localized ionizing radiation from decaying ^{125}I atoms could not be ruled out, particularly in T1 phage. (auth)

Nuclide Kinetics and Toxicology

Refer also to abstracts 25587 and 25602.

25887 CONTAMINATION BY BONE-SEEKING RADIONUCLIDES AND RADIOPROTECTION. 5. International Meeting of the French Society of Radiation Protection, Grenoble, France, February 1, 1971. Montrouge, France; Societe Francaise de Radioprotection (1971). 727p. (In French and English). (CONF-710211).

Forty-one papers were presented at the conference. One of them was presented in abstract form. One paper appeared previously in NSA as abstract number 25: 29513. Separate abstracts were prepared on the other 39 papers. (France)

For abstracts of individual papers see: 25888, 25891–25904, and 25915–25938.

25888 IMPORTANCE OF BONE-SEEKING ELEMENTS IN HIGHLY IRRADIATED OR SLOWLY COOLED NUCLEAR FUELS. Schaeffer, R. (Electricite de France, Paris). pp 647-61 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The activities of bone-seeking elements produced by fission and activation reactions with U increase with the level of irradiation to which the fuel is subjected. A predominance of bone-seeking transuranic elements occurs with the high level irradiations encountered in industrial installations. This phenomenon is even more pronounced if the cooling takes place slowly. (France)

Man

Refer also to abstract 27610.

25889 POTASSIUM AND ^{137}Cs CONCENTRATIONS IN HUMANS AS AFFECTED BY SEX, RACE, AGE, WEIGHT, AND TIME OF MEASUREMENT. Scott, L. M. (Union Carbide Corp., Oak Ridge, Tenn.). Health Phys.; 22: No. 4, 393(Apr 1972).

At the Oak Ridge Y-12 plant, 20,000 measurements of K and ^{137}Cs were made on subjects monitored in 1968. Sex, race, age, and weight significantly affected body burdens of K and ^{137}Cs at the 1% level of statistical confidence. Males had 21% more K than females, and blacks 6.5% more than whites. The K fell exponentially with age at the rate of 0.75%/yr. Weight had little effect below 180 lb, but above this weight, K decreased with weight increase. Females averaged 36% less ^{137}Cs than males, and blacks 24% less than whites. The ^{137}Cs burden decreased exponentially at about 0.03%/yr from age 20 yr through 59 yr. There was little difference in the ^{137}Cs burdens for weight groups of 140 lb or more, but those groups less than 140 lb were considerably lower. There was a large variation in ^{137}Cs burdens with time, a peak level of 13nCi occurring in 1959 and 21nCi in 1964. Since 1968 the average ^{137}Cs level has remained constant at 2.8nCi. (UK)

25890 DISTRIBUTION OF GALLIUM IN HUMAN TISSUES AFTER INTRAVENOUS ADMINISTRATION. Nelson, Bill; Hayes, Raymond L.; Edwards, C. Lowell; Kniseley, Ralph M.; Andrews, Gould A. (Oak Ridge Associated Universities, Tenn.). J. Nucl. Med.; 13: No. 1, 92-100(Jan 1972).

To provide data for radiation dosimetry of ^{67}Ga, recently introduced for scanning tumors, we have tabulated the tissue distribution of 23 autopsies after intravenous administration. Relatively high concentrations were usual in the spleen, renal cortex, adrenal, and marrow but assays showed a wide range of values in all tissues. We have also illustrated with autoradiograms an uneven distribution in certain tissues. The radiation dose to those tissues is influenced by cellular localization because much of the energy from ^{67}Ga decay is expended by electrons with a very short range. (auth)

25891 QUANTITY OF ^{90}Sr IN HUMAN TEETH AND BONES IN ROMANIA. Weissbuch, H. (Istitutul de Sanatate Publica si Cercetari Medicale, Iasi); Botezatu, E.; Racoveanu, N. pp 110-17 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

It is well established that the distribution of fallout is not constant over the earth's surface; most of the radioactive precipitations fall in the septentrional hemisphere (between the 35 deg and 65 deg parallels). Rumania has a population of 20 million and is situated between the 43 deg 37′ and 48 deg 15′ parallels in the septentrional hemisphere. The climate is transition continental, temperate, with an annual precipitation of 640mm.

The results of investigations made on the quantity of ^{90}Sr in the teeth and bones of the population as a function of the ages of the individuals investigated are presented. (France)

25892 PRELIMINARY ANALYSIS OF THE CONCENTRATIONS OF ^{90}Sr IN THE VERTEBRAE OF NEWBORN BABIES IN ITALY. Karhausen, L. (CEN, Fontenay-aux-Roses, France); Vacca, G.; Legoff, J.; Lanzola, E. pp 118-34 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

Vertebrae bone samples of newborn babies and those that had died before their twelfth day were collected from five regions of Italy. Sampling was effected during 1967, 1968, and 1969. The results indicate a decrease in bone contamination over these three years, which is not influenced by age or sex. It was observed that the ^{90}Sr concentration was distinctly higher in the Udine region than in the other regions, and also that the concentration of stable Sr was distinctly lower in the Udine region than in the other regions. The ^{90}Sr concentrations in the Udine region correspond to those observed in Denmark, Finland, Norway, the USSR, and Argentina. (France)

25893 BONE BURDEN RESULTING FROM ALIMENTARY INGESTION OF ^{90}Sr IN ADULTS, DISCUSSION ON THE RESULTS OBTAINED AND RETENTION PARAMETERS NECESSARY IN CALCULATING ADMISSIBLE LEVELS. Garnier, A. (CEN, Fontenay-aux-Roses, France); Lanzola, E. pp 135-56 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The specific burden of vertebrae arising from radioactive contamination by ^{90}Sr following alimentary ingestion of this element by adults from Milan was calculated. A retention model based on the distinction between bone stability and exchangeable Ca, and similar parameters deduced from measurements made in France, was used. The agreement with measurements made on vertebrae bone samples is satisfactory. These results are useful for the determination of the retention parameters defined by the ICRP, applicable under constant and continuous contamination conditions with adults. The maximum admissible levels are subsequently calculated. (France)

25894 RADIOSTRONTIUM IN MAN AS A FUNCTION OF AGE. Beninson, D.; Migliori de Beninson, A.; Menossi, C.; Kramer, J. (Comision Nacional de Energia Atomica, Buenos Aires). pp 157-217 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The parameters affecting the contamination of human bones (in Argentina) were studied as a function of age and the quantity of ^{90}Sr present in the diet. The turnover rate of the bones and the Sr/Ca discrimination factors were estimated for the different age groups from determinations of the $^{90}Sr/Sr$ specific activity and the Sr/Ca ratios. The turnover rate is high for small infants (21 days to 2 yrs old), but diminishes by 20% during the second year. An additional increase in the turnover is observed between the sixth and fourteenth year. Above this age, the turnover rate again decreases. The discrimination between Sr and Ca is low for small infants; it increases at about the third year and remains constant during adult life. (France)

25895 CONTAMINATION OF HUMAN BONES AND DIET BY THE ^{90}Sr, AN ATTEMPT TO ESTABLISH A TRANSFER MODEL. Coulon, R.; Madelmont, C. (CEN, Fontenay-aux-Roses, France). pp 218-51 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The results of investigations on contamination of the diet and bones of humans with ^{90}Sr were used to establish a transfer model enabling reliable predictions on long term risks to be made. The kinetics of ^{90}Sr are defined in relation to those of Ca. In adults, the model represents two types of Ca turnover: fast and slow. Results obtained using data gathered between 1962 and 1969 and a computerized version of the model indicate that the fast type of Ca represents 5% and 3% of the total bone Ca in the vertebrae and ribs respectively and that complete renewal occurs within a year or more. The remaining slow type Ca has a turnover rate of 9% and 6% per year for the vertebrae and ribs respectively. (France)

25896 DOSIMETRY OF β-EMITTERS IN BONE: THEORETICAL METHODS. Whitwell, J. R.; Spiers, F. W. (Univ. of Leeds, Eng.). pp 401-17 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

According to recent evidence, tissues within the spaces in trabecular bone are specially vulnerable to malignant transformation by radiation. New methods were developed to calculate the dose absorbed by the entire marrow and by cells lining the endosteal surfaces of the trabeculae. Monte Carlo calculations are used, based on the probabilities that β particles pursue certain paths in transversing trabecular bone. The mensuration data specifying the bone structure were obtained experimentally from postmortem specimens, using a photoelectric scanning microscope. Results are given for radionuclides with mean β particle energies ranging from 0.049 MeV (for ^{14}C) up to 1.127 MeV (for $^{90}Sr+^{90}Y$), and for representative specimens of trabecular bone from the human skeleton. An assessment of the contribution of the cortex was made for each bone specimen, both sets of results were averaged for the skeleton. Results are given for the absorbed dose received by the active marrow from β emitting radionuclides deposited uniformly throughout the skeleton. (France)

25897 DOSES RECEIVED AS A RESULT OF MEDICAL TESTS USING BONE-SEEKING RADIOISOTOPES. Moroni, J. P.; Remy, M. L. (Service Central de Protection contre les Rayonnements Ionisants, Le Vesinet, France). pp 472-501 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

A knowledge of the dose delivered during medical examinations using radioelements (particularly bone-seeking elements) is indispensable from several aspects: it allows the results of each particular examination to be established, taking into account their value, and the risks involved; in the case of systematic examinations the idea of risk must be considered at the level of the population; the development of new techniques implies the acceptance of a compromise between the quality of the information obtained, which is dependent upon the activity used, and the exposure received by the individual. In the absence of guides acting as recommendation or rules, as exist in other fields of radioprotection, it is important to compare the doses with those delivered by other diagnostic techniques (particularly the use of x rays), and with other ways by which individuals can receive doses. (France)

25898 TUMOR INCIDENCE AND LIFE SPAN OF HUMAN RADIUM CASES. Stehney, A. F.; Rowland, R. E. (Argonne National Lab., Ill.). pp 502-15 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

A total of 71 malignant neoplasms were identified in human patients treated with radium and considered to be caused by radiation. The incidence of these malignancies is zero below about 1000 rads and rises to a peak at about 10,000 rads. Functions of the type $I = K_1 D \exp(-D/D_1)$ and $I = K_2 D^2 \exp(-D/D_2)$, where I is the fractional incidence and D the dose in rads, duplicate the general shape of the distribution over the entire dose range. However, quantitative studies of the best fits to the data show that neither function is in statistical agreement with both the zero incidence in the low dose ranges and the sharp increase observed above 1000 rads. Indications of life shortening were sought by comparing survival rates for women radium cases in different dosage groups. By means of a life-table method, the percent surviving as a function of time after first exposure was calculated for women in dose ranges of less than 1 rad, 1 to 100 rads and 100 to 1000 rads. (France)

25899 EFFECT OF CERTAIN SUGARS ON CALCIUM ABSORPTION. Pansu, D. (Univ., Lyon); Chapuy, M. C. pp 549-64 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The action of various compounds (glucides, lactose, xylose, and sorbitol) on calcic absorption was studied for humans. Lactose increased the intestinal absorption of ^{47}Ca with 9 out of the 11 individuals investigated, and increased the level of Ca in the body by reducing the fecal Ca in 13 out of 20 individuals. The effect was reversed in 4 out of 20 cases, in which lactose induced an intestinal calcic discharge. A simultaneous investigation of the glycemia and calcemia after the administration of lactose and Ca established the significant inverse relation between the values demonstrating that the action of sugar is inversely proportional to the digestibility. The compounds studied probably act by their presence (event under intestinal illumination) and this modifies the in situ osmotic equilibrium. Jejunal perfusion confirmed that calcium may be absorbed countercurrent to the water and sodium flux. (France)

25900 WHOLE-BODY SCINTIGRAPHY OF MAN WITH ^{87m}Sr AND ^{85}Sr. Lahneche, B.; Verot, R. (Centre de Lutte contre le Cancer Leon-Berard, Lyon). pp 584-92 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The isotopes, ^{87m}Sr and ^{85}Sr, were used in the diagnosis of 250 patients suffering from osteoarthritis, particularly with neoplasms. These patients retained a large quantity of radioactive Sr, and exhibited a very low elimination rate for tracers in the skeleton and organism (decay with a biological half-life of 15 to 20 days during the first months), a maximum retention of tracers in the skeleton and a very unequal distribution of radiostrontium in the skeleton: certain regions may receive doses several times greater than the mean dose calculated on the assumption of a homogeneous distribution of the tracer in the skeleton. (France)

25901 CERTAIN ASPECTS OF RADIOPROTECTION RECOMMENDATIONS CONNECTED WITH THE USE OF RADIOELEMENTS AS NONSEALED SOURCES. Moroni, J. P. (Service Central de Protection contre les Rayonnements Ionisants, Le Vesinet, France). pp 662-9 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The idea of a maximum admissible dose was voluntarily excluded from the domain of the medical uses of ionizing radiations, account being taken of the strong motivation for its use. Guides are however necessary in this domain and recommendations, which have, in fact, already been published, are reviewed. The establishment of a system of rules applicable to technical developments, and relevant to the results of examinations must involve: a sufficiently accurate measurement of the doses delivered; predicting the effects on the patient and population as a whole; comparing the resulting benefits of an examination with the risks involved. In reality these conditions limit the precision obtainable. The medical use of nonsealed radioelement sources is a new technique currently being developed; radioprotection rules can be partially respected by rationalizing and planning developments in the technique. (France)

25902 CALCULATION OF THE SOLUBLE FRACTION OF INHALED BONE-SEEKING ELEMENT COMPOUNDS IN THE ORGANISM LIQUIDS FROM CHANGES IN URINARY EXCRETION WITH TIME. Schaeffer, R. (Electricite de France, Paris). pp 670-83 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

When contamination results from inhalation, the soluble fraction of the radionuclide (fraction rapidly crossing the lung wall) varies with the nature and the grain size of the compounds. Two accidental contaminations by inhalation involving two different ^{239}Pu forms, described in the literature, are used as examples. The calculation is based upon the comparison between the first urinary excretions and the lung burden measured by whole-body counting. The solubilities observed were 17% for Pu oxide and 85% for Pu chloride. (France)

25903 EFFECTIVE ENERGY OF BONE-SEEKING ELEMENTS ACCORDING TO THE TYPE OF CONTAMINATION (SINGLE OR CONTINUOUS). Schaeffer, R. (Electricite de France, Paris). pp 684-702 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The effective energy varies with time, this variation being particularly important for certain bone-seeking elements. The value adopted by the C.I.P.R. for calculating the maximum admissible concentration for each radionuclide corresponds to a 50 yr exposure to a continuous contamination; this value can be applied directly to dosimetric calculations concerning a single contamination. Values obtained for the effective energy appropriate to this type of contaminations are presented, two models being considered for the biological elimination: exponential function for a normalized man and a power function. (France)

25904 REFERENCE MAXIMUM PERMISSIBLE BODY BURDENS USED IN WHOLE BODY COUNTING TECHNIQUES. Schaeffer, R. (Electricite de France, Paris). pp 703-21 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The maximum permissible body burdens established by the C.I.P.R. suppose continuous contamination by a single radionuclide in an entirely soluble form. The present work considers the case of a single contamination in an insoluble form and gives the maximum permissible body burdens corresponding to the principal bone-seeking elements. These values are generally less than those indicated by the C.I.P.R. Some weighting is necessary when treating the case of contamination by mixtures of nuclides. (France)

25905 SPECIFIC ACTIVITY APPROACH FOR DERIVING MPC FOR RADIONUCLIDES IN PLANT PRODUCTS. Kamath, P. R.; Bhat, I. S.; Pillai, K. C. (Bhabha Atomic Research Centre, Bombay). pp 167-73 of Radiation and Radioisotopes in Soil Studies and Plant Nutrition. Bombay; Dept. of Atomic Energy (1971).

From Symposium on radiation and radioisotopes in soil studies and plant nutrition; Bangalore, India (21 Dec 1970). See CONF-701227.

A discussion is presented of the ICRP recommendations for maximum permissible amounts of radionuclides in the daily diet and drinking water. The influence of stable calcium and potassium on the uptake of ^{137}Cs and ^{90}Sr is pointed out. The calculation of specific activity of radionuclides in plant foods of daily diet is discussed and a table is presented showing results for ^{90}Sr, ^{137}Cs, ^{65}Zn, ^{59}Fe, ^{58}Co, and ^{131}I. Tables are also given for limiting ratios of specific activities and safe permissible activities in the body for the same isotopes. ICRP recommendations for maximum permissible body burdens are also discussed. (H.L.W.)

Animals

25906 (CEA-R-4263) METABOLIC STUDY OF THE BINDING OF PLUTONIUM TO SERUM PROTEINS. Nenot, Jean-Claude; Morin, Michele; Massey, Pierre; Lafuma, Jacques (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec 1971. 11p. (In French). (EUR-4712). Dep. NTIS (U. S. Sales Only).

The metabolism of plutonium-transferrin complexes was studied in rats. Double labeling of transferrin by ^{59}Fe and ^{239}Pu demonstrated fast migration from the site of intramuscular administration, similar distribution patterns with either muscular or intravenous injections, the unbinding of the transferrin-plutonium complex and, above all, significant deposits of plutonium in bone. Using ^{238}Pu, more accuracy still was achieved in the knowledge of the element distribution after intramuscular or intravenous injections of the transferrin-plutonium complex; within one week, 93% migrated from the site of intramuscular injections and 70% of the migrating fraction was deposited in bone. (auth)

25907 (RLO-1750-46) RADIOECOLOGY OF ^{65}Zn IN ALDER SLOUGH, AN ARM OF THE COLUMBIA RIVER ESTUARY. Renfro, William C. (Oregon State Univ., Corvallis. Dept. of Oceanography). [1970]. Contract AT(45-1)-1750. 43p. Dep. NTIS.

The Columbia River Estuary is a large area with physical features complicated by such forces as semi-diurnal tides, varying river discharge, storm waves, and littoral drift. In this area the river water, with its characteristic organisms and chemical composition previously influenced primarily by terrestrial processes, interacts with oceanic waters having quite different chemical and biological constituents. A discrete segment of the estuary within which the cycling of radionuclides could be studied and the effects

of tides, salinity changes, and other environmental variables could be assessed was selected for radioecology studies. Seasonal changes in the concentration of ^{65}Zn, total zinc, and ^{65}Zn specific activities in water, sediments, plants, and animals, and the rate at which ^{65}Zn is turned over by organisms were studied beginning in early April 1966 and extending through 1967. During July 1966 the shutdown of the Hanford reactors for a period of about 45 days caused a reduction in the input of ^{65}Zn to the estuary. This situation presented an excellent opportunity to examine the response of all components of the Alder Slough ecosystem to such an alteration. (auth)

25908 (RLO-1750-73) ^{210}Pb IN SELECTED MARINE ORGANISMS. Beasley, Thomas Miles (Oregon State Univ., Corvallis). Jun 1969. 93p. Dep. NTIS.

Thesis.

The concentrations of ^{210}Pb were determined in a variety of benthic and surface invertebrates and vertebrates collected from the Northeast Pacific Ocean. The specimens analyzed were taken during different times of the year and consequently during different hydrographic regimes which afforded the opportunity to compare ^{210}Pb concentrations in organisms living in upwelled water further from shore. Less extensive measurements of ^{210}Po in the same species permitted an estimate of the radiation dose rate to which these organisms may be subject from this internally deposited isotope. (67 references) (C.H.)

25909 (RLO-1750-76) ^{55}Fe IN PACIFIC OCEAN ORGANISMS. Jennings, Charles David (Oregon State Univ., Corvallis). 31 Jan 1968. 90p. Dep. NTIS.

Thesis.

Large quantities of ^{55}Fe, formed by nuclear testing during 1961 and 1962, have been deposited on the North Pacific Ocean as fallout and concentrated by marine organisms. As a result of this high ^{55}Fe fallout and of low concentrations of iron in the ocean, marine organisms are the site of high ^{55}Fe specific activity (^{55}Fe activity/weight of total iron). Iron-55 specific activity was seen to vary among five species of Pacific salmon from 1964 through 1967, with sockeye salmon showing highest and chinook salmon showing lowest ^{55}Fe specific activity. Variation of ^{55}Fe specific activity among species of salmon appears to result from their migration routes and feeding habits. From 1964 to 1967 the ^{55}Fe content in salmon decreased, and from this decrease an eightfold decrease in ^{55}Fe in the surface layer of the ocean, corrected for physical decay to the time of initial input, was observed. The accumulated input of ^{55}Fe into central Alaska, measured in lichen, was found to be 209 nCi/m^2 and a calculation of the ^{55}Fe present in the North Pacific Ocean from ^{55}Fe specific activity in salmon was found to be 6.1×10^5 nCi/m^2. (C.H.)

25910 (RLO-1750-78) DETERMINATION OF ^{65}Zn SPECIFIC ACTIVITY IN VARIOUS TISSUES OF THE CALIFORNIA SEA MUSSEL, MYTILUS CALIFORNIANUS. Larsen, Ingvar Lauren (Oregon State Univ., Corvallis). Jun 1971. 67p. Dep. NTIS.

Thesis.

The specific activity of ^{65}Zn (nanocuries ^{65}Zn/g total Zn) was determined in various organs of the common coastal mussel, Mytilus californianus, collected from six locations along the Pacific Coast. These organs included the gills, mantle, foot, reproductive organs, adductor muscle, and viscera. After ashing and dissolving with nitric acid (8 M), each tissue was analyzed for ^{65}Zn by gamma-ray spectrometry. The determination of total zinc concentrations of the various organs was accomplished by atomic absorption spectrophotometry and by neutron activation analysis. Variable amounts of both stable zinc and ^{65}Zn were observed within the specific tissues of animals from a given location. The ^{65}Zn specific activities of the tissues of organisms from a particular station however, tended to be uniform, at least within the uncertainty of the measurements. An estimate of the input specific activity from the mussel's environment (food and/or water) was calculated from a simple model and resulted in a value similar to zooplankton values sampled from within the Columbia River plume. (auth)

25911 (UR-3490-46) RETENTION AND EXCRETION OF INJECTED $Na_2{}^{181}WO_4$ IN BEAGLE DOGS. Aamodt, Roger L. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [1971]. 24p. Dep. NTIS.

Retention and excretion of ^{181}W were measured in purebred beagle dogs, 18 months old, given 1.5 to 2.3 μCi of sodium 181-tungstate in normal saline. The dogs were injected in the cephalic vein with 1 to 1.5 ml of the tungsten solution. Urine and feces were collected separately and body burdens were determined during a 131 day period by whole-body gamma counting. The excretion data generally agree with whole-body γ measurements. Blood was taken until its activity dropped below the limit of detection of the counter. Loss from the blood was rapid during the first 24 hours post-injection and most of the activity was found in the plasma. Comparison of excretion in urine and feces indicate that loss occurs predominantly in the urine with only a very small fraction removed by way of the feces. (auth)

25912 (UR-3490-73) MEASUREMENT OF THORON IN THE BREATH OF DOGS ADMINISTERED INHALED OR INJECTED ThO_2. Ballou, J. E.; Hursh, J. B. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [nd]. 17p. Dep. NTIS.

The thoron (^{220}Rn) content of the breath was measured in dogs following inhalation or injection of ^{228}Th-enriched ThO_2. Immediately after exposure, thoron release to the breath was less efficient from inhaled ThO_2 than from ThO_2 injected intravenously. After approximately two weeks, when the inhaled burden was localized in the lungs, the efficiency of thoron release to the breath was increased by one-half and exceeded that following other modes of administration. The lowest release values were found following intramuscular injection. The ratio relating thoron in the lung space to ^{228}Th in the lung remained fairly constant for a period of 150 days after inhalation exposure. Applying this ratio to periodic breath thoron measurements, the half-time for clearance of ThO_2 from the lung was estimated to be 350 days. (auth)

25913 STUDY OF THE DISTRIBUTION OF ^{131}I AFTER ITS ADMINISTRATION TO THE RAT. Tei, Tensen (Nagasaki Univ., Japan). Nagasaki Igakkai Zasshi; 46: No. 3-4, 71-81(Apr 1971). (In Japanese).

Medical treatment using radioisotope-labeled drugs has made rapid progress in recent years, and their influence on human health has become an important question. The purpose of this study is to clarify such significant questions as where and how ^{131}I, which is present in most of the labeled drugs, is distributed, concentrated and excreted in the body and how much of the radiation dose is present in each organ. But as the direct estimation of radioactivity in the human body was impossible except in some special organs, the radioactivity of the entire body and separate organs and tissues was traced over a period of time in rats after the administration of ^{131}I and the criteria for estimating the radiation dose was determined. The radioactivity of the entire body rapidly decreased by the 2nd day after the administration, and after the 4th day it decreased in index and function. The radioactivity in the thyroid gland and blood decreased in index and function from the 4th day after the administration. The radioactivity of such organs and tissues as the ovary, testis, liver, kidney, spleen, muscle, small intestine plus contents and bone marrow rapidly equilibrated with that of the blood, there being a constant ratio between the two concentrations almost from the beginning. However that of the stomach and its contents took a week to equilibrate with that of the blood. When the amount of the radiation dose varied its distribution in the body changed. (Japan)

25914 LONG TERM EFFECTIVE HALF-LIVES FOR ^{210}Pb AND ^{210}Po IN SELECTED ORGANS OF THE MALE RAT. Torvik, Edward. Cincinnati; Univ. of Cincinnati (1971). 202p. University Microfilms Order No. 72-1434.

Thesis.

The influence of lead-210 on the effective half life of polonium-210 in various organs of the male rat was investigated. One hundred fifty Charles River male rats were injected in the lateral tail vein with an equilibrium solution of RaDEF (25 μCi/kg) at a pH of 6.4. Five to six rats were sacrificed for each data point over 135 days post injection period. The skull, femur, spine, kidney, gonads, spleen, liver, lungs, blood, and heart were removed, weighed, and analyzed for their polonium-210 and lead-210 content. These data were plotted on semi-logarithmic paper and the long term effective half-lives were determined by the method of linear regression analysis for the straight line portion of the curve. The retention curves for lead-210 can be expressed by means of a two component exponential equation for the soft tissues and a single component exponential equation for all bone samples. The long-term half-life of lead-210 in the soft tissues ranged from 18 to 100 days, and in bone from 65 to 109 days. The time required for the soft tissues to lose 50% of the initially deposited lead-210 ranged from 1 to 7 days. The retention curves for polonium-210 for the spleen and kidney can be expressed by means of a single component exponential equation. The retention curves for polonium-210 for the other soft tissues could be expressed by means of a two component exponential equation. The retention curves for polonium-210 in bone required a multi-component exponential equation. The effective half-life of polonium-210 in soft tissues ranged from 34 to 112 days, and in the three bone types analyzed it ranged from 41 to 58 days. The effective half-life values determined in this investigation were compared with Stannard's adjusted values and experimental values were 40 to 90% greater in the kidney, liver, lung, spleen, and bone. Therefore, the assumption made by the

ICRP that long term effective half-life values determined for single radionuclides will not differ significantly from those determined for the same radionuclide when it is generated within an organ as a result of the radioactive decay of another radionuclide was not confirmed in this investigation. The highest concentration of lead-210 and polonium-210 at the end of 140 days was found in the femur of the rat. Of all the soft tissues analyzed, the kidney had the highest lead-210 and polonium-210 concentration. The liver, lungs, blood, and heart had approximately the same concentration of lead-210. The concentration of polonium-210 in liver, lungs, heart, and gonads differed from each other by less than a factor of two. The hypothesis that the biological half-life of polonium-210 was equal to the biological half-life of lead-210 in bone was supported by this study, since the calculated F-ratio values were compared with the experimentally measured values, and the slope of the line of "best fit" —calculated by linear regression analysis—did not differ, at the 95% confidence level, from the theoretical value of one. The F-ratio calculated for man—using the assumption that the biological half-life of lead (3650 days listed by ICRP) in bone is equal to the biological half-life of polonium deposited in bone from the decay of lead-210—was 0.86, in close agreement with Holtzman's measured human bone value of 1.0 ± 0.2. These data are particularly significant in that they would suggest a reduction in the maximum permissible concentration. This study confirms the fact that polonium is selectively retained by the soft tissues, whereas lead is mainly to be found in bone tissue. The data also indicate that soft tissue half-life and distribution values for polonium-210 will be influenced by the release of polonium-210 from the bone compartment. The effect of the released polonium will become greater as the F-ratio in bone reaches its maximum value. (Diss. Abstr. Int., B)

25915 DEPENDENCE OF THE RETENTION OF RADIOACTIVE Sr BY THE SKELETON OF THE RAT ON THE CHEMICAL COMPOUND ADMINISTERED. Weissbuch, H.; Leporda, G.; Diaconescu, C.; Sangereanu, O.; Cotrau, A. (Istitutul de Sanatate Publica si Cercetari Medicale, Iasi). pp 19-26 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The chemical form in which Sr penetrates the organism strongly influences the metabolism of this isotope. When administered in the forms of strontium chloride, strontium lactate, and strontium carbonate (all being labeled with ^{85}Sr), differences were observed between the amounts of radioactive Sr in the skeleton, which depended upon the chemical composition. It was observed that the Sr retention with the chloride, lactate, and carbonate was respectively 36.4%, 29.2%, and 20%. The bone retention is precocious and rapidly exceeds that of the plasma. The equations describing the elimination process have an exponential form. (France)

25916 EFFECT OF THYROID PRODUCTS ON THE MITOCHONDRIAL UPTAKE OF ^{85}Sr. Tine, J. (Hopital Militaire d'Instruction Percy, Clamart, France); Rocquet, G.; Michel, R. pp 27-47 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

Hepatic mitochondria fix large quantities of Sr^{2+}, both in the in vivo state and the isolated state. The concentration of the cations by the isolated particles produces at the same time an increased respiration. These mechanisms, like those affected by thyroidian products are linked with oxydo-phosphorylations. The effects of 3:4:3' triiodo-L-thyronine (T3), and its acetic metabolite (TA3) associated with Sr^{2+}, on the mitochondrial functions, were studied. The hepatic mitochondria were prepared and preserved in 0.25M sucrose, their oxygen consumption being measured polarographically (G.M.E. oxygraph). The $SrCl_2$ (labeled with ^{85}Sr) uptake was determined by fast filtration with a 0.45 μ Millipore. (France)

25917 INFLUENCE OF FOOD AND AGE ON THE ^{85}Sr KINETICS IN THE RAT. Volf, V.; Polig, E. (Kernforschungszentrum, Karlsruhe, Ger.). pp 48-57 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

A study of the ^{85}Sr kinetics in rats revealed a high rate of transfer across the intestinal walls; the rate is higher in young animals than in the adult, and higher after administration by injection than after ingestion. In the case of injection, intestinal excretion and reabsorption of ^{85}Sr occur under optimum conditions, whereas in the case of ingestion, the intestinal re-excretion of ^{85}Sr depends upon the nutritional state of the animal, and the fecal excretion of endogenous ^{85}Sr. Furthermore, after ingestion, a fraction of the ^{85}Sr contained in the plasma might possess a small affinity for the bone tissue. (France)

25918 EFFECT OF NUTRITION ON THE DEGREE OF CONTAMINATION OF THE RAT WITH ^{85}Sr. Fournier, P.; Dupuis, Y. (Ecole Pratique des Hautes Etudes, Paris). pp 58-67 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

Under identical administration conditions, the absorption and retention of alkaline earths vary considerably with the type of diet given to the rat, and to whether or not, the diet includes substances such as vitamin D and lactose. Four different types of diets are examined: the first is designated normal; the second contains vitamin D and results in an enhanced retention; the third contains a high proportion of lactose, which when ingested simultaneously with ^{85}Sr, significantly increases the fixation of this contaminating element; the fourth diet, lacking in utilization factors, leads to large perturbations in the utilization of Ca, and after a week of this diet, an extremely high uptake of ^{85}Sr by the bones. (France)

25919 EFFECT OF SEX ON THE CONTAMINATION OF THE RAT BY ^{85}Sr. Fontaine, N. (Ecole Pratique des Hautes Etudes, Paris). pp 68-77 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The degree of contamination by ^{85}Sr of the rat depends to a certain extent on its sexual state. Up until six months, the contamination is the same for both sexes. At nine and fourteen months, the female presents a higher level of contamination than the male (about 50% greater); with very old animals, the difference is even more marked (tending towards 100%). The contamination differences between different males vary very little, while females, however, retain alkaline earth elements in function of the phase in the estrous cycle, the contamination being greatest during estrus. In spite of the bone lesions resulting from an ovariotomy, this does not modify the degree of contamination, which depends upon the diet employed. (France)

25920 EXPERIMENTAL DATA ON THE DIGESTIVE ABSORPTION OF ALKALINE EARTH METALS. Labat, M. L. (CEN, Fontenay-aux-Roses, France). pp 78-84 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The principal manner in which alkaline earths contaminate bones is through digestive absorption. Previous research has demonstrated the importance of certain alimentary glucides in increasing the intestinal absorption of alkaline earths and producing a hypermineralization of the skeleton. This effect was observed in young and old rats. It was possible to demonstrate that the mechanism consists of an intestinal hyperabsorption and a decrease in the bone catabolism. Actinomycin D and an experimental scheme from which the exact values of the intestinal absorption could be read off enabled the dependence of this phenomenon on protein transport to be determined. (France)

25921 CHRONIC ADMINISTRATION OF ^{85}Sr TO THE SOW, PASSAGE OF PRODUCTS DURING GESTATION AND LACTATION. Villiers, P. A.; Daburon, F.; Remy, J. (CEA, Jouy-en-Josas, France). pp 85-100 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

Sows (of the Corsican species) were chronically contaminated with ^{85}Sr, both before and after the gestation period. The evolution of the body burden sustained by these sows was followed together with the burdens accumulated by the fetus. In addition, piglets of these sows, and other noncontaminated sows were studied and the ^{85}Sr body burdens determined for the cases when

the mothers milk was contaminated or was not contaminated, and also after nursing. The evolution of the body burden of chronically contaminated sows does not appear to be significantly modified by the state of gestation. The piglets of such sows triple their body burdens during lactation; Sr obtained in this way is however rapidly eliminated after nursing ceases. In contrast, Sr obtained in utero is eliminated very slowly from the system. (France)

25922 INTENSIFIED Sr EXCRETION DURING LACTATION IN RATS AND THE INFLUENCE OF AGE ON THIS PROCESS. Kollmer, W. E.; Kriegel, H. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neuherberg, Ger.). pp 101-9 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The time for which lactating rats retain a single dose of radioactive Sr is reduced in comparison with virgin reference specimens. This reduction is not uniquely due to the secretion of the Sr in the milk, but also to excretion in the urine and feces. The excretion of the radiostrontium, during a period of nine days after the uptake of the isotope, was studied. During the nursing period this excretion increases relative to the virgin reference specimens, with young animals and decreases with older animals. Young female parents, from which the litter had been removed, followed the same rule. In older animals there was comparatively little excretion. (France)

25923 ELIMINATION BY LACTATING RUMINANTS OF ^{226}Ra FROM DRAINING WATER FROM URANIUM MINES WHICH HAS BEEN DRUNK. Hanout, R. (CEA, Jouy-en-Josas, France); Daburon, F.; Ballada, J. pp 252-63 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

Two ewes and a cow were chronically contaminated with ^{226}Ra, being given daily draining water from a uranium mine. The Ra is eliminated in three ways: intestinally, by the kidneys, or by the mammae. Fecal excretion represents 99% of the total, the remainder being shared between the urine and the milk. It was found that the fraction found in the milk was relatively constant and independent of the quantity of milk produced. The relation between the Ra concentration in the milk to that in the water is between 0.5 and 1 part per thousand. (France)

25924 ^{252}Cf DISTRIBUTION IN RAT TISSUE AND BONE. Mewhinney, J. A.; Ziemer, P. L.; Landolt, R. R. (Purdue Univ., Lafayette, Ind.). pp 264-96 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

Present knowledge on the deposition of ^{252}Cf in animal tissue and bone is based primarily on reports on the systematic behavior of actinide elements in mammals. Because of the need to confirm such behavior for ^{252}Cf, studies were conducted to determine the distribution and bone deposition of ^{252}Cf in rats. The nuclide was administered in the form of a citrate complex by intraperitoneal injection into seven groups of six rats. Tissue and bone deposition were determined by sacrificing the groups after 1, 2, 4, 8, 16, 32, and 64 days. Special emphasis was given to the determination of local depositions in bone using contact alpha autoradiography on hand-ground sections of noncalcified bone. Whole-body retention was also determined for the 64 day group by whole-body counting techniques. (France)

25925 EXPERIMENTAL STUDY OF THE EVALUATION OF ^{239}Pu, ^{241}Am, ^{238}Pu, ^{242}Cm BODY BURDENS USING DIFFERENT METHODS OF ADMINISTRATION. Morin, M.; Nenot, J. C.; Lafuma, J. (CEN, Fontenay-aux-Roses, France). pp 297-314 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

Classical methods of evaluating the bone burdens after contamination with transuranic radionuclides involve mathematical calculations based on the daily quantities eliminated in the urine, these being representative of the fraction initially fixed by the skeleton. These calculations are based upon data obtained after intravenously administering a defined ^{239}Pu complex. In reality, the diffusion in the organism is never instantaneous, but follows an evolution. If part of the diffused fraction fixes in the skeleton, another part is eliminated in the urine. The daily elimination in the urine reflects the degree of diffusibility of the element, which depends upon its physicochemical form and its mode of entry into the system. In contrast, the secondary distribution in the organs is fairly constant, and there exists a ratio between the fixation in the skeleton and the cumulated urinary excretion, which can be used to estimate the bone burdens. (France)

25926 EFFECT OF THE PHYSICOCHEMICAL STATE AND MODE OF ADMINISTRATION ON THE BONE UPTAKE OF ^{144}Ce, DECONTAMINATION BY DTPA. Skupinski, W.; Lafuma, J. (CEN, Fontenay-aux-Roses, France). pp 315-32 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The distribution of ^{144}Ce in rats after its administration in various physicochemical forms, either as aerosols or by intramuscular or intravenous injection, was studied. The rate at which the Ce diffuses after its introduction, the distribution in the different organs, the biological half-life, and the quantity eliminated, depend upon the physicochemical form administered and the mode of administration. In every case, the skeleton retained the largest quantity of Ce. The action of DTPA on the metabolism of Ce was studied in view of local and general treatment. (France)

25927 EFFECT OF ISOTOPE DILUTION ON THE BEHAVIOR OF ^{88}Y IN THE RAT. Seidel, A.; Vladar, M.; Volf, V. (Kernforschungszentrum, Karlsruhe, Ger.). pp 333-9 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The distribution, kinetics, and fixation of ^{88}Y by plasma proteins after intravenous injections containing doses between 0.01 and 10 μmol per animal were studied. Increasing the dose up to 1 μmole per animal results in a slowing down of the ^{88}Y elimination from the plasma; this process reverses with doses containing higher concentrations. Isotopic dilution results in a decrease in the concentration in the skeleton and an increase in the concentration in the kidney, proportional to the dose concentration. The liver behaves exceptionally, inasmuch as its ^{88}Y concentration is smaller for a 1 μmole dose than for a 0.1 μmole dose. While the deposition rate in the liver and kidney is greater for small doses, the skeleton exhibits opposite behavior. Molecular filtration with a Sephadex gel indicates a chelaton of the ^{88}Y together with the formation of colloids, which are dispersed and composed in a manner depending upon the dose concentrations. (France)

25928 MICROSCOPIC DISTRIBUTION OF SHORTLIVED α-EMITTING BONE SEEKERS STUDIED BY QUANTITATIVE AUTORADIOGRAPHY. Hindringer, B.; Goessner, W. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neuherberg, Ger.). pp 340-59 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

Quantitative autoradiography of bone tissue was performed after administering ^{224}Ra, a volume seeker, and ^{227}Th, a surface seeker. In order to study these water soluble isotopes, a rapid method of embedding in methacrylate was developed together with a method for mounting the sections on a photographic emulsion without any contact with water. The number of autoradiograph tracks yielded the relative distribution of these nuclides in different areas of the bone (periosteum, endosteum, compacta) and in the various parts of the skeletons (tibia, spine, mandibula) of mice. The relation between the number of α tracks on the surface and in the volume was about 3:1 for ^{224}Ra and about 7:1 for ^{227}Th. After incorporating a 25 μCi/kg body weight of ^{224}Ra, the activity in the tibia diaphysis was 1.5 time greater than in the mandibula. The distribution of the activity in different sites of the skeleton seems to be connected with the different tumor incidence. The topographic distribution of ^{224}Ra in other organs is demonstrated. (France)

25929 MARROW ABSORBED DOSE-RATES IN BONES OF BEAGLE DOGS RAISED ON DIETS CONTAINING ^{90}Sr. Zanelli, G. D. (Univ. of Leeds, Eng.); Darley, P. J.; Goldman, M. pp 381-400 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971).

From fifth international meeting of the French Society of Radia-

tion Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The mean marrow dose in different parts of five bones taken from beagle dogs raised on diets containing various amounts of ^{90}Sr, was measured. The flesh was cleaned from the bones, they were cut into sections, and the marrow was removed using a jet of hot water. After drying, the marrow spaces were filled with CaF_2; Mn grains having a mean size of 1.78μ. The phosphor was left in the bones for between 10 and 20 days, it was then removed, and the luminescent output/unit weight was measured using a commercial TLD reader. By calibrating the reader using CaF_2: Mn exposed to a known dose of ^{60}Co γ radiation, the mean dose rate received by the powder in the bone was calculated. (France)

25930 DISTRIBUTION OF INCORPORATED α-EMITTING BONE-SEEKERS IN MICE, AND DOSE CALCULATIONS. Mueller, W. A. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neuherberg, Ger.). pp. 434-48 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The metabolism of ^{224}Ra (administered in chloride form) and ^{227}Th (administered in citrate form) in NMRI-mice was studied. Both nuclides were found to be well deposited in the bone tissue a few days after i.p. injection. The mean total average doses to the skeleton were about 35 rads per μCi/kg of ^{224}Ra and about 200 rads per μCi/kg of ^{227}Th injected. The local and temporal distributions of the nuclides and the doses were compared to those already published for long-lived Ra and Th isotopes. Of the soft tissue organs, the spleen exhibits a relatively high ^{224}Ra specific activity in young males. In older animals there are smaller differences between sexes, the female and the male possessing an extremely high ^{224}Ra content in the spleen (specific activities even greater than those in the bone). (France)

25931 IN VIVO DOSIMETRY OF ANIMALS CONTAMINATED WITH A BONE-SEEKING RADIOISOTOPE, ^{90}Sr. Parmentier, N. C.; Bassant, M. H.; Mimicos, N. (CEN, Fontenay-aux-Roses, France). pp 449-71 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

An attempt to measure (in vivo) the dose absorbed in the neighborhood of bones of rats contaminated by ^{90}Sr, is described. In order to test the validity of the results, measurements obtained from dosimeters surgically placed along the femur and frontal bone, are studied in relation to the measured activities. These results are then compared with in vitro measurements made with deproteinized bones, crystals of LiF being introduced in the marrow canal and intertrabecular spaces. Autohistoradiographs enabled the modifications in the fixation of the ^{90}Sr brought about in the bones by the in vivo introduction of the dosimeters to be studied. (France)

25932 INJURIOUS EFFECT OF ^{90}Sr ON THE DOG SKELETON. Vlasov, P. A.; Burykina, L. N. (Inst. of Biological Physics, Moscow). pp 516-27 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The effect of ^{90}Sr was studied by allowing dogs to ingest small doses over a period of several years. As a result, the following modifications were observed: an enhanced aging, and an unequal distribution of ^{90}Sr in the bones leading to difficulties in the physiological regeneration of bone tissues. The possible occurrence of radiation-induced bone tumors is much greater particularly in flat bones, where the dose absorbed by the tissue is greatest, and at the same time, the reorganization processes most marked. (France)

25933 EARLY AND LATE EFFECTS OF INCORPORATED ^{224}Ra IN MICE. Goessner, W.; Hindringer, B.; Hug, O.; Luz, A.; Mueller, W. A. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neuherberg, Ger.). pp 529-48 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

In order to obtain information on the long-term effects of short-lived radionuclides, experiments on the incorporation of ^{224}Ra in mice are being studied. The short-lived ^{224}Ra isotope produces osteosarcomas after single injections in mice. In the 5 to 50 μCi/kg dose range (about 150 to 1500 rads mean dose to the skeleton), ^{224}Ra produces a 15% incidence of osteosarcomas with female mice over the whole dose range. In males, the tumor incidence is lower, varying from 2 to 8% with the dose. Experiments that have taken place over a period of 2 yrs with a 2.5 μCi/kg source (about 30 to 75 rads mean dose to the skeleton) reveal an osteosarcoma incidence, which, in terms of the average dose to the skeleton, is greater than after the application of ^{226}Ra. (France)

25934 EFFECT OF ORAL SODIUM ALGINATE ON THE RETENTION OF RADIOACTIVE BARIUM IN THE RAT. Humphreys, E. R.; Howells, G. R. (Medical Research Council, Harwell, Eng.). pp 593-8 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

Experiments are described that show that the addition of glucuronic acid-enriched sodium alginate to the diet of rats decreased retention of barium by 84% when it was given by mouth and by approximately 10% over four days when the barium was injected. (France)

25935 EFFECT OF THE CHEMICAL FORM OF ALGINATES ON Sr UPTAKE IN THE RAT. Maillard, M. J. (CEN, Fontenay-aux-Roses, France). pp 599-608 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

Sodium alginates have already been successfully used to fix Sr in the alimentary canal. The relation between their capture and the length of the polymer chain (i.e. viscosity) is discussed; two sodium alginates in 1% solution were tested: a short chain polymer (viscosity 50 centipoise); a long chain polymer (viscosity 500 to 600 centipoise). The behavior of Sr towards insoluble alginates such as alginic acid and Ca alginate is considered. The investigation was made from the following points of view: the respective stabilities when the alginate–^{85}Sr combination is made before its introduction into the alimentary canal; the ability of alginates to trap Sr when introduced into the digestive tracts of a fasting rat, and a digesting rat. The fixation of ^{85}Sr with the two Na alginates is very similar. Alginic acid and Ca alginate capture about the same proportions of Sr. (France)

25936 COMPARISON OF SOME METHODS FOR DECREASING RADIOSTRONTIUM ABSORPTION FROM THE GUT. Kostial, K.; Maljkovic, T.; Slat, B. (Inst. for Medical Research, Zagreb). pp 609-19 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The effectiveness of different doses and forms of phosphates, sulfates, and alginates in decreasing the radiostrontium absorption by the intestines was investigated with fasting and fed 8 to 9 week old female albino rats after a single oral application of ^{85}Sr and ^{47}Ca. All of these substances produced a decrease in the absorption of radiostrontium and a slight or zero reduction in the Ca absorption. The effect of the treatment was generally more pronounced with fasting animals than with fed animals. The present and previous results indicate that a simultaneous application of both calcium phosphate and sodium alginate might be the best way of reducing radiostrontium absorption from the intestine in cases of acute and prolonged contamination with radiostrontium. (France)

25937 EXPERIMENTAL STUDY OF SOME METABOLIC ASPECTS OF CONTAMINATION BY RADIOACTIVE ZIRCONIUM: CHANGES INDUCED BY CERTAIN SUBSTANCES IN THE BONE UPTAKE OF THIS NUCLIDE. Rinaldi, J. P.; Gavend, M.; Blanc-Brude, C.; Rinaldi, R. (CEN, Grenoble, France). pp 620-39 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971). (In French).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

The metabolism of radioactive zirconium citrate and oxalate solutions by the rat was studied together with the modifications induced by various decontaminating substances. Metabolic equilibrium concerns essentially the distribution of $^{95}Zr-^{95}Nb$ after

contamination with solutions having different physicochemical properties and in particular with some solutions obtained after passage through Sephadex. The results obtained establish the bone tropism of $^{95}Zr-^{95}Nb$; autoradiographic investigations of the bones enabled the Zr distribution to be determined; accumulation is favored at active osteogenesis sites. It is shown that the polycarboxylic acids do not affect the metabolism of $^{95}Zr-^{95}Nb$, whereas significant modifications are obtained with heavy metal salts. Zirconium citrate revealed itself to be the most efficient; it has an effect on the bone fixation and urinary elimination. (France)

25938 ^{85}Sr DECORPORATION WITH A CRYPTATING AGENT. Mueller, W. H. (CEN, Fontenay-aux-Roses, France). pp 640-4 of Contamination by Bone-Seeking Radionuclides and Radioprotection. Montrouge, France; Societe Francaise de Radioprotection (1971).

From fifth international meeting of the French Society of Radiation Protection; Grenoble, France (1 Feb 1971). See CONF-710211.

In relation to the law postulating that complexing agents have higher stabilities with the cation (which should thus be removed from the mammal system) than with the corresponding Ca^{++} ion, Sr is eliminated using a new complex former, a cryptating agent. (France)

25939 DISTRIBUTION OF ^{140}La IN COMPONENTS OF THE MITOCHRONDRIAL MEMBRANE. Tashmukhamedov, B. A.; Gagel'gans, A. I.; Mamatkulov, Kh. M. (Inst. of Biochemistry, Tashkent). Uzb. Biol. Zh.; No. 4, 68-9(1971). (In Russian).

The distribution of ^{140}La between various components of the mitochondrial membrane was investigated in rat liver. Small amounts of radioactivity were found in acetone extracts and in $CHCl_3$-methanol extracts of the liver, but >90% of the ^{140}La remained in the protein residue. (K.S.W.)

25940 EFFECT OF PULSATING WATER JET LAVAGE ON RADIOACTIVE CONTAMINATED WOUNDS. Grower, Marvin F.; Bhaskar, Surindar N. (Walter Reed Army Medical Center, Washington, D. C.). J. Dent. Res.; 51: No. 2, 536-8(Mar-Apr 1972).

Zinc-65 was introduced into facial wounds of rats to simulate natural contamination. The quantitative effects of a bulb syringe, single pulsed water jet, and a multiple pulsed water jet on decontamination of the wounds were determined by counting the radioactivity that remained in the wounds after treatment. The water jet devices were shown statistically to reduce contamination more than the bulb syringe. (auth)

Plants

Refer also to abstract 25570.

25941 EXPERIMENTAL STUDY OF THE CONTAMINATION OF ZEA MAYS SPRAYED WITH WATER CONTAINING RADIOSTRONTIUM AND RADIOCESIUM. Delmas, J.; Disdier, R.; Grauby, A.; Bovard, P. (Centre d'Etudes Nucleaires de Cadarache, Saint-Paul-les-Durance, France). Radioprotection; 6: No. 4, 269-78(1971). (In French).

The consequences of irrigating Zea mays with water contaminated with ^{90}Sr and ^{137}Cs was studied from the points of view of the uptake and the distribution in different parts of the plant and as a function of the way in which the irrigation was performed; the relation between the level of contamination of the water and that of the different parts of the plants was established. The experiments were conducted so as to simulate the contamination likely to be encountered under agricultural conditions. Spraying with contaminated water was carried out in a large test room. In addition, experiments were conducted in which the radionuclide deposits were effected on soils contained in tanks. Studies were also undertaken using plants contained in pots. The results obtained demonstrate that maize may be an important factor in the transfer of ^{90}Sr and ^{137}Cs from the environment to the diet. (France)

25942 STUDIES ON THE UPTAKE AND TRANSPORT OF RADIOSTRONTIUM IN PLANTS. Athalye, V. V.; Mistry, K. B. (Bhabha Atomic Research Centre, Trombay, India). pp 127-42 of Radiation and Radioisotopes in Soil Studies and Plant Nutrition. Bombay; Dept. of Atomic Energy (1971).

From Symposium on radiation and radioisotopes in soil studies and plant nutrition; Bangalore, India (21 Dec 1970). See CONF-701227.

Seedlings of beans (Phaseolus vulgaris) were grown in polyethylene jars containing culture solutions. Strontium-89 was administered to three-week old plants and accumulation factors were calculated; the time course of uptake by roots and shoots is shown by means of graphs. A table is presented to show distribution of ^{89}Sr in roots, stems, and leaves. Data from the literature on ^{89}Sr uptake by barley, maize, and peas was used for comparison with experimental data and a table is presented to show species effects. Effects of variations in pH and salt concentrations and effects of metabolic inhibitors on ^{89}Sr uptake in beans were also investigated and results are tabulated. (H.L.W.)

25943 DISCRIMINATION BETWEEN RADIUM AND CALCIUM IN THE SOIL-PLANT SYSTEM. Bhujbal, B. M.; D'Souza, T. J.; Mistry, K. B. (Bhabha Atomic Research Centre, Trombay, India). pp 155-65 of Radiation and Radioisotopes in Soil Studies and Plant Nutrition. Bombay; Dept. of Atomic Energy (1971).

From Symposium on radiation and radioisotopes in soil studies and plant nutrition; Bangalore, India (21 Dec 1970). See CONF-701227.

Three types of soil, alkaline black clay, acidic red loam, and laterite, were used in the experiments. The distribution of radium and calcium between the soil solution and the soil was examined by comparing the extent to which ^{226}Ra and ^{45}Ca added to equilibrium soil solution were removed by the soil. Maize (Zea mays) and bean (Phaseolus vulgaris) plants were grown in the three soils labeled with ^{226}Ra and ^{45}Ca. After three weeks the shoots were harvested and assayed for ^{226}Ra and ^{45}Ca. Data indicated that the absorption of radium by plants grown in the three soils was considerably lower than that of calcium. The plant soil factor (ratio of $^{226}Ra/^{45}Ca$ in shoots to $^{226}Ra/^{45}Ca$ added to soil) showed strong discrimination against ^{226}Ra in the transfer from soil to plant. (H.L.W.)

Microorganisms

25944 (RLO-2227-T-12-18) ^{65}Zn UPTAKE BY A BACTERIUM ISOLATED FROM ALDER SLOUGH, COLUMBIA RIVER ESTUARY. Tonjes, Stephen Dodd (Oregon State Univ., Corvallis). Jun 1971. 38p. Dep. NTIS.

Thesis.

Bacteria were isolated from water at Alder Slough, Oregon. Of 15 isolates grown successfully in the medium employed, 100% showed measurable uptake of ^{65}Zn. It was concluded that bacterial uptake of ^{65}Zn and other metal cations must be considered in determining the fates of these materials released into the environment. (auth)

New Tracer Techniques

25945 QUANTITATIVE FEATURES OF A SANDWICH RADIOIMMUNOLABELING TECHNIQUE FOR LYMPHOCYTE SURFACE RECEPTORS. Nossal, G. J. V.; Warner, N. L.; Lewis, Heather; Sprent, J. (Walter and Eliza Hall Inst. of Medical Research, Melbourne). J. Exp. Med.; 135: No. 2, 405-28(1 Feb 1972).

The present study was designed to devise and characterize an indirect or sandwich radioimmunolabeling technique for the study of lymphocyte surface receptors of immunoglobulin nature. Mouse lymphocytes from various sources were treated by the method of Shortman et al. to remove debris and damaged cells. This was an important preliminary step, as without it, little meaning could be attached to bulk scintillation counting of labeled cell suspensions, in view of the marked tendency of dead or damaged cells to adsorb protein nonspecifically. Next, cells were reacted at 0°C for 30 min with graded dilutions of unlabeled rabbit antisera against defined mouse Ig chains. After washing, the cells were reacted with a sheep anti-rabbit globulin reagent labeled with ^{125}I, again at graded concentrations. After further washing, lymphocyte labeling was quantitated by both bulk scintillation counting and radioautography. Conditions were defined in which nonthymus-derived cells (B cells) but not thymus-derived cells (T cells) could be labeled. Most B cells displayed κ- and μ-chains on their surface, but some also displayed α- and γ_2-chains, though in smaller amounts. When the concentration of both the first and the second reagents was raised considerably, conditions were defined under which virtually all T cells could be labeled by polyvalent antiglobulin sera, anti-κ sera, or, with more difficulty, by anti-μ sera. A large series of control experiments confirmed the serologic specificity of this labeling. It was shown that under equivalent conditions, B cells bind 100 to 400 times more antiglobulin than do T cells. The theoretical implications of the results are briefly discussed. It is argued that the sandwich approach offers certain technical advantages over direct labeling procedures for further analyses of T cell receptors and for studies of receptor metabolism. (auth)

25946 BORON AUTORADIOGRAPHY OF BOTANICAL SPECIMENS. Stinson, Robert H. (Univ. of Guelph, Ont.). Can. J. Bot.; 50: No. 1, 245-6(Jan 1972).

Boron autoradiographs of plant material may be obtained on a new commercially available film. Samples and film are placed in a neutron source. The film records the location of boron atoms by detecting alpha particles emitted from boron after neutron capture. The film is completely insensitive to gamma rays, which usually cause undesirable darkening when this technique is used with conventional photographic film. Variation in content of boron in sunflowers grown at varying boron concentrations was easily detected. Boron tends to accumulate at the tip and along the margins of the leaf. (auth) (Canada)

25947 NOVEL METHOD FOR MEASURING INCORPORATION OF RADIOACTIVE PRECURSORS INTO NUCLEIC ACIDS AND PROTEINS OF CELLS IN MONOLAYER CULTURE. Ball, C. R.; Poynter, R. W.; van den Berg, H. W. (School of Medicine, Leeds, Eng.). Anal. Biochem.; 46: No. 1, 101-7(Mar 1972).

A straightforward, rapid, and accurate method for assaying the incorporation of radioactive precursors into nucleic acids of small numbers of cells is described. It was confirmed that 6-^{3}H-thymidine and 5-^{3}H-uridine are specific labels for DNA and RNA, respectively, in HeLa cells. (M.C.G.)

MATERIALS

Ceramics and Cermets

Refer also to abstracts 25437, 25439, 25998–26000, 26032, 26033, 26070, 26103, 26143, 27320, 27326, 27328, 27331, and 27341.

25948 (AAEC/TM–600) THERMAL DECOMPOSITION OF UO_3 HYDRATES. Rundle, D. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1971. 13p. Dep. NTIS (U. S. Sales Only).

Thermal decomposition, crystal structure, and methods of preparation of the various compounds formed between UO_3 and H_2O are reviewed. A preliminary study of the thermal decomposition of single crystals of α-$UO_2(OH)_2$ is described. Hot-stage optical microscopy was used to determine physical changes that accompany decomposition, and single crystal x-ray diffraction helped to identify both the decomposition products and their preferred orientations. (auth)

25949 (AERE-R–6611) CERAMIC-FUELS COMPRESSIVE-CREEP RIG. Stratton, R. W. (Atomic Energy Research Establishment, Harwell (England)). Apr 1971. 13p. Dep. NTIS (U. S. Sales Only).

The specifications, production, and performance of a Harwell compressive-creep rig for studying the creep behavior of uranium dioxide under irradiation at 750°C are discussed. The scientific requirements are outlined and the solutions to come of the design problems arising out of creep measurement in a reactor environment are given. A description of the rig and its performance over seven cycles of reactor operation is included, together with a preliminary creep curve. (auth)

25950 (BNWL–286) MAGNETIC FORCE WELDING OF TUNGSTEN–URANIUM DIOXIDE COMPOSITES. Final Report. Shaw, C. H.; Boolen, R. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 24 Jan 1966. Contract AT(45-1)-1830. 56p. (NASA-CR–54839). Dep. NTIS.

Declassified 27 Oct 1971.

Tungsten–20 vol% UO_2 composites in thin plate and cylindrical (rolled) form were effectively joined by magnetic force butt welding. Metallography showed uniform bonding and no undesirable effect on UO_2. Transverse cracking, however, was experienced in a majority of the specimens. (auth)

25951 (CNLM–3800) MEASURED LINEAR THERMAL EXPANSION, 68–1800–68F OF TWO LOTS OF BeO AND THREE LOTS OF BeO + 35 VOL % UO_2. Harrington, L. C. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 23 Aug 1961. Contract AT(30-1)-2789. 12p. Dep. NTIS.

Declassified 4 Nov 1971.

The thermal expansion behavior of two commercial lots of BeO was studied in heating and cooling cycles to 1800°F. Reversible expansion was observed after one to two such cycles. The thermal expansion behavior of BeO–35 vol % UO_2 was similarly studied. No correlation of expansion measured for BeO–35 vol % UO_2 was found with expansion computed from data for BeO and UO_2, respectively. (auth)

25952 (CNLM–3981) THERMAL EXPANSION OF BERYLLIUM OXIDE PLUS 50 OR 35 VOLUME PERCENT URANIUM DIOXIDE. Harrington, L. C. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 20 Feb 1962. Contract AT(30-1)-2789. 14p. Dep. NTIS.

Declassified 4 Nov 1971.

Results of tests are presented which show that heating and cooling of specimens of BeO + 50 or 35 volume percent UO_2 produces smooth expansion rates not very different from that of BeO. Specimens of these compositions heated in an atmosphere in which they could pick up oxygen showed similar expansion rates at ≤2000°F and an expansion at a more rapid rate in the range 2400 to 2800°F. Distortions in sample configuration were found in all specimens. (J.R.D.)

25953 (CNLM–4318) HEAT CAPACITY AND ENTHALPY OF URANIUM MONOCARBIDE FROM 0 TO 1200C (32 TO 2200F). Harrington, L. C. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 9 Nov 1962. Contract AT(30-1)-2789. 3p. Dep. NTIS.

Declassified 4 Nov 1971.

Results of measurements using an ice calorimeter are presented. The values for enthalpy and heat capacity are in agreement with those obtained in other investigations. The data are presented graphically. (J.R.D.)

25954 (IJS-P–272) INVESTIGATION OF THE PROCESS OF BINDERS AND LUBRICANTS ADDITION AND REMOVAL IN CERAMIC NUCLEAR FUEL FABRICATION. Susnik, Dimitrij (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Oct 1971. 38p. (In Slovenian). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Ljubljana Univ., Yugoslavia.

The influence of organic additions, binders, and lubricants, on pressing, green strength, density, and microstructure of the UO_2 pellets are described. Best results are achieved with addition of stearic acid solution as binder and lubricant to the UO_2 powder. During presintering in CO_2 atmosphere, binders and lubricants decompose at about 200°C, whereas the rest of carbon reacts with hyperstoichiometric oxygen UO_{2+x} in CO_2 giving CO_2 and UO_2. Sintered UO_2 pellets were found to contain less than 30 ppM carbon. (auth)

25955 (IS–2684) CHARACTERIZATION AND CONTROL OF THE DESTRUCTIVE CRYSTALLINE TRANSFORMATION IN HAFNIUM OXIDE. Wilder, D. R.; Buckley, J. D.; Stacy, D. W.; Johnstone, J. K. (Ames Lab., Iowa. National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). [1971]. 38p. (CONF-710926-3). Dep. NTIS.

From Symposium on the study of crystalline transformations at high temperatures above 2000°K; Odeillo, France (27 Sep 1971).

The tetragonal-monoclinic crystalline transformation in hafnium oxide can be suppressed by additions of calcium oxide, magnesium oxide, yttrium oxide, or several of the rare earth oxides. The effects of these additions are considered, and tentative phase equilibrium diagrams are given for HfO_2–Y_2O_3 and HfO_2–Er_2O_3. X-ray diffraction and measurement of thermal arrest by optical means are the major analytical methods employed. Analysis of the systems reported indicated yttrium oxide as the best additive if thermal-mechanical properties govern the intended application. The nuclear properties of erbium oxide make it a logical choice where hafnium oxide is to be used for reactor applications. (auth)

25956 (LA-DC–72-187) HOT HARDNESS TESTING OF URANIUM–PLUTONIUM CERAMICS. Tokar, M.; Green, J. L. (Los Alamos Scientific Lab., N. Mex.). [1970]. 15p. (CONF-711046–1). Dep. NTIS.

From Symposium on hardness testing; Detroit, Mich. (Oct 1971).

Studies were made on the temperature variation of the hardness of carbides and nitrides of Pu and U, especially the solid solution which has a nominal composition of UC–20 mole % PuC, as a function of both carbon composition and U/Pu ratio for use as potential LMFBR fuels. The data were correlated with possible deformation mechanisms. In the case of PuN, hardness data were obtained as a function of temperature and were compared to literature values for UN and (U,Pu)N. The results showed that Pu-containing monocarbides and mononitrides do not yield the classic Ito–Shishokin hardness curves. The nonlinearity of the carbide curves at low homologous temperatures may be caused by impediments to dislocation motion of the vacancy-impurity type. (P.C.H.)

25957 (MDC-G–3136) PLUTONIA/CURIA COMPATIBILITY TESTING. Quarterly Report No. 13, October–December 1971. Andelin, R. L.; Watrous, J. D. (McDonnell Douglas Astronautics Co., Richland, Wash. Donald W. Douglas Labs.). Jan 1972. Contract AT(45-1)-2138. 26p. Dep. NTIS.

Microprobe analyses of plutonia/barrier material/iridium container test combinations after exposure at 1500°C for 1000 hours confirmed and extended the results previously reported. The iridium capsules were not attacked by either plutonia or the hafnia barrier but reacted with the molybdenum barriers and tantalum-alloy containers. A set of 22 plutonia fuel aging specimens was assembled and placed on test. However, variable fuel quality appeared to require changes in the fuel aging portion of the program plan to maximize return on the program investment. Evaluation has begun on curia-244-refractory metal specimens exposed at 1800°C for 12,000 hours and 2000°C for 10,000 hours, plutonia-refractory metal specimens exposed at 1800°C for 15,000 and 18,000 hours, and plutonia–molybdenum cermet and solid-solution cermet refractory alloy system specimens exposed at 1500 and 1800°C for 5000 hours. (auth)

25958 (ORNL-tr–2554) STUDIES ON THE Ni–Nb–O SYSTEM AND ON THE EQUILIBRIUM OF REDUCTION OF NICKEL NIOBATE. Abbatista, Fedele; Tkatchenko, Evghanij Victorovitch; Chiantaretto, Giampaolo. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Atti. Accad. Sci. Torino. I. Cl. Sci. Fis., Mat. Natur.; 103: 605-25(1969). 22p. Dep. NTIS.

The phase diagram of the system Ni–Nb–O at 1250°C was determined by means of a study of the reduction equilibria and

roentgenographic specimens. The two niobates of nickel, $NiO \cdot Nb_2O_5$, $NiO \cdot Nb_2O_5$ can coexist in equilibrium with each other, elemental nickel, and with respect to NiO and partially reduced phases of the Nb_2O_5 type. The niobate $NiO \cdot Nb_2O_5$ on reduction forms metallic nickel and simultaneously the whole series of phases with a moderate content of oxygen of the type of those which are found in the binary system Nb_2O_5–NbO_2. On the basis of the results obtained, considerations were developed on the resistance to oxidation of Nb–Ni alloys in relation to the constitution of the protective layers which are formed on the metallic surface. (auth)

25959 (SC-RR-720031) ZIRCONIA–YTTRIA SYSTEM ABOVE 2000 C. Skaggs, Samuel Robert (Sandia Labs., Albuquerque, N. Mex.). Jan 1972. 119p. Dep. NTIS.

Thesis. Submitted to Univ. of New Mexico, Albuquerque.

The zirconia–yttria phase diagram was completed by preparing 254 spherules 2 to 2.5 mm diameter fused from premixed powder pellets with a 250 watt continuous wave carbon dioxide laser. The 10.6 μm infrared laser radiation is invisible to the eye, to photographic film, and to optical pyrometry. Other advantages of the laser as an imaging heat source are its continuously variable power, and its simplicity of operation. Spherule temperatures were measured on both pendant drops and falling drops. Fifty-two liquidus temperature measurements by automatic photoelectric pyrometer were made on pendant spherules from previously analyzed groups. Cooling curves and phase transformations were measured by recording light intensity vs time on a photomultiplier-oscilloscope combination. Temperature conversion from intensity data was obtained using Planck's law. Pendant spherules were allowed to cool slowly to achieve crystal and chemical equilibrium. Falling droplets were quenched from approximately 2100 to 87°K by liquid argon. Cooling times of 1 to 1.5 seconds from 3200 to 87°K were achieved. The 2 to 2.5 mm diameter spherules were divided. One part was examined by x-ray diffraction using the 114.6 mm Debye–Scherrer powder camera. The data were fitted by a Nelson–Riley correlation to determine the lattice parameter a_0. A petrographic thin-section was prepared of the other part of the spherule. Microscopy and electron microprobe analysis were performed on the thin-section to determine crystal structure and chemical composition. Ninety-four spherules of compositions varying from 0.1 to 98.6 mole % Y_2O_3 in ZrO_2 were examined by the x-ray powder diffraction method for lattice parameter, and by the electron microprobe x-ray analyzer for chemical composition. Data from the quenched spherules are in excellent agreement with the work of Duwez et al. (1951) and Ruh et al. (1968). The complete phase diagram is constructed from the data of Duwez et al. (1951), some unpublished data compliments of Ruh et al. (1968), and the measurements made in these experiments. New features include the appearance of the maximum temperature on the liquidus curve at ~10 mole % Y_2O_3 rather than at 20 to 25 mole % Y_2O_3 found by the previous investigators, a peritectic isotherm at 2483°C, and a peritectic composition located at 75 mole % Y_2O_3. All other features of the phase diagram appear in previously published work. The method demonstrates the successful use of the carbon dioxide laser as a heat source to study refractory oxide systems without the use of a container. (auth)

25960 (TID-25973) STRENGTH OF CEMENTED CARBIDES AS RELATED TO THEIR CONSTITUTION. Technical Paper EM71-902. Gurland, J. (Brown Univ., [Providence, R. I. Div. of Engineering]). [1970]. 14p. Dep. NTIS.

The structure and constitution of cemented carbides for use as tool materials are discussed in relation to their function; considering, in turn, the properties of the carbide and binder phases, the thermodynamic phase diagram, the liquid phase sintering mechanism, and the mechanical interaction of the constituents in the aggregate. (41 references) (P.C.H.)

25961 MECHANICAL INTERACTION BETWEEN FUEL AND CLADDING. Aas, S. (Institutt for Atomenergi, Kjeller, Norway). pp 165-200 of Advanced Course on Limiting Aspects of Fuel Element Performance in Water Cooled Power Reactors. Kjeller, Norway; Institutt for Atomenergi (1971).

Mechanical interaction between UO_2 pellet fuel and the cladding is due to greater expansion of the fuel because of its higher temperature and to fuel swelling and cracking. The extent and nature of the interaction is dependent on the gap, length of the pellets, end shape of the pellets, heat load, rate of power increase, and cladding properties. The stress-strain pattern usually has a changing multiaxiality with consequent varying strains to fracture, and the strains may be concentrated over small lengths of the cladding. The properties of Zircaloy are adversely affected by irradiation and to avoid difficulties the pellet shape, dimensions and density, and cladding properties should be chosen with due regard to reactor system conditions. The way the reactor is loaded and operated is also a factor determining fuel life. Many of the processes described are not known precisely and there is need for many more in-pile measurements. In addition the measurement of heat production and channel power should be to a similar degree of accuracy. (Norway)

25962 BORON. VOLUME 3. PREPARATION AND PROPERTIES. Proceedings of the International Symposium on Boron, Warsaw, June 25–29, 1968. Niemyski, T. (ed.). Warsaw; Polish Scientific Publishers (1970). 299p. (CONF-680677-(Vol.3)).

Thirty-one articles are included. The topics covered include properties and structure of B with special consideration for β-rhombohedral B, determination of C in iodide boron and in elemental B, hydrogen absorption in B, preparation of pure α- and β-rhombohedral B, preparation of B compounds, crystal structure of AlB_{10} and C_4AlB_{24}, polyhedral groups in the phase SiB_6, crystal chemistry of higher borides, structure and properties of polyborides, magneto-resistance in B to 100 kOe, photoconduction of B crystal, optical constants of β-rhombohedral B in the region 1 to 6 eV, magnetoconductivity and surface conductivity in B, relaxation processes in crystalline B, and drift mobility of carriers in B. (P.C.H.)

25963 OPERATION WITH FUEL MELTING. Freshley, M. D. (Battelle-Northwest, Richland, Wash.). pp 227-43 of Advanced Course on Limiting Aspects of Fuel Element Performance in Water Cooled Power Reactors. Kjeller, Norway; Institutt for Atomenergi (1971).

Although the basic technical feasibility of operating Zircaloy-clad oxide fuels with fuel melting has been demonstrated, several important considerations associated with this mode of operation require further investigation before general acceptance can be expected. Included are statistically significant satisfactory operating experience to high burnup under power reactor conditions, the possible effects of molten fuel contacting the cladding, and defect behavior which may impose the most serious performance limitation. As fuel designs become more advanced, the need for operation with fuel melting becomes better defined. However, potential advantages must be considered in relation to any associated additional risks. A comprehensive assessment of advantages versus risks associated with fuel melting is not possible based upon presently available technology. (Norway)

25964 COMPARISON OF PELLET AND VIPAC NUCLEAR FUELS. Freshley, M. D. (Battelle-Northwest, Richland, Wash.). pp 201-26 of Advanced Course on Limiting Aspects of Fuel Element Performance in Water Cooled Power Reactors. Kjeller, Norway; Institutt for Atomenergi (1971).

Under the operating conditions presently employed or projected for commercial power reactors in the near future, neither pellet nor vipac fuels appear to be confronted with inherent performance limitations. However, the fuel cycle must be economical and it is inevitable that advances in reactor design will ultimately result in higher heat ratings and burnup requirements for the fuel. There are indications that vipac fuel may possess performance advantages over pellet type fuel as higher heat ratings and burnups are demanded. The lower thermal conductivity of vipac fuel results in higher fuel temperatures than in pellet rods operating under similar linear heat ratings. Changes which occur during radiation reduce the effects of differences in the two fuel types and their thermal performance capability becomes more comparable. Although most behavioral characteristics for pellet and vipac fuels are similar, core-clad mechanical interaction and ability to accommodate swelling may constitute significant differences. Because there is significantly more experience with pellet fuels and because there is presently little incentive to consider vipac fuels, they are not generally accepted for commercial application. (auth) (Norway)

25965 STRUCTURAL ASPECTS OF THE METAL-INSULATOR TRANSITIONS IN Cr-DOPED VO_2. Marezio, M.; McWhan, D. B.; Remeika, J. P.; Dernier, P. D. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., B; 5: No. 7, 2541-51(1 Apr 1972).

The temperature–composition phase diagram of $V_{1-x}Cr_xO_2$ with $0 \leq x \leq 0.025$ is found to contain four phases: rutile (R), normal monoclinic VO_2 (M_1), and two monoclinic phases (M_2 and M_3). For M_2 with $x = 0.024$ at 298°K, $2a_R \approx a_M = 9.0664$, $2c_R \approx b_M = 5.7970$, $a_R \approx C_M = 4.5255$ Å, and $\beta = 91.88°$. The M_2 and M_3 regions are separated by a volume discontinuity. There are two types of V atoms in these structures. The first type form pairs and the second type form zigzag chains along the b_M axis. This contrasts with VO_2 where all the vanadium atoms are paired. The structures R, M_2, and M_3 with $x = 0.024$ have been refined from single-crystal x-ray data. High-pressure resistivity and x-ray measurements vs temperature give $dT(M_2 \rightarrow R)/dP = -(0.9 \pm 0.1)$°K/kbar and $V_R - V_{M_2} = -0.11$ cm³/mole VO_2. At higher pressures $dT(M_3 \rightarrow R)/dP = (0 \pm 0.2)$°K/kbar. These results cannot

be simply interpreted in terms of the homopolar bond model proposed for the M_1 phase of VO_2. (auth)

25966 METHOD FOR EXCHANGING COUNTERIONS IN ACTINIDE OXIDE SOLS. Thomas, Iran L. (to United States Atomic Energy Commission). U. S. Patent 3,629,138. 21 Dec 1971. Filed 16 Oct 1969.

A method for exchanging counterions, such as nitrates and chlorites, in acidic metal oxide sols comprises contacting a nitrate-stabilized metal oxide sol with carbon dioxide, removing the released nitrate and contacting the carbon dioxide-stabilized colloidal system with a chloride-containing solution to form a chloride-stabilized metal oxide sol. This method is applicable to preparation of stabilized acidic oxide sols of U, Th, Pu, or mixtures of these. (Official Gazette)

25967 CERIUM–OXYGEN–CARBON SYSTEM. Clark, N. J. (Flinders Univ. of South Australia, Adelaide); McColm, I. J. J. Inorg. Nucl. Chem.; 34: No. 1, 117-23(Jan 1972).

For the C–Ce–O system it is established by x-ray analyses and hydrolytic studies that no discrete cerium oxide–carbides exist in argon arc melted preparations. At lower temperatures the existence of a series of oxide–carbides of cerium based on isomorphous replacement of oxide ions by C_2^{2-} ions in the reduced cerium oxides is established. One hexagonal oxide–carbide of composition $CeO_{1.48}(C_2)_{0.07}$ was isolated from the products of the cerium metal plus carbon monoxide reaction at 1300 to 1600°C and is described. A discrete orthorhombic oxide–carbide phase, $Ce_4O_2C_2$, was also isolated from the Ce + CO reaction, which cannot be described on an isomorphous oxide ion replacement model. It is established by hydrolysis that neither of these phases contains C_1 units in its structure. (auth)

25968 Th–N–O PHASE DIAGRAM. Benz, R. (Los Alamos Scientific Lab., N. Mex.). J. Nucl. Mater.; 43: No. 1, 1-7(Apr 1972).

Phase boundaries in the $Th–ThO_2–Th_3N_4$ phase region were determined micrographically. The monotectic previously reported to exist in the binary $Th–ThO_2$ system is concluded to exist only at temperatures of 2800°C and above and at nitrogen atom fractions of less than 0.1. With increasing temperature, solubility of ThN in ThO_2 at the $ThO_2–ThN$ pseudobinary first becomes detectable (ca 0.5 mole percent ThN) at about 2550°C. The solubility increases with increasing temperature and reaches the value of 10 mole % ThN in 100 torr nitrogen at 2660 ± 50°C. Molar solubilities of Th and ThO_2 in ThN (coexisting with thorium and ThO_2) are substantially equal and range from 0.02 mole % at 1600 to 0.06 mole % at 2100 to zero at 2600°C and above. A ternary peritectic reaction is postulated to occur at 1760 ± 40°C involving the phases ThO_2, ThN, β–Th, and liquid. A ternary eutectic reaction occurs at 1690°C between the phases ThO_2, liquid, and postulated nitrogen-rich β–Th and nitrogen-lean β′–Th phases at the atom fractions of $X_O = 0.04$, $X_N = 0.015$, and $X_{Th} = 0.945$. (auth)

25969 ANISOTROPY RATIO OF THERMAL DIFFUSIVITY IN PYROLYTIC GRAPHITE OVER THE TEMPERATURE RANGE FROM 300 TO 1600°C. Nasu, S.; Takahashi, T.; Kikuchi, T. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Mater.; 43: No. 1, 72-4(Apr 1972).

The thermal diffusivity (α) of pyrolytic graphite in the temperature range from 300 to 1600°C was investigated using the laser flash method which was first developed by Parker et al. and extended by other investigators. Results are presented graphically. An equation for calculation of diffusivity is also included. (J.R.D.)

25970 IRREGULARITIES IN THE U_3Si_2 DIFFRACTION PATTERN. de Vooght, D.; De Meester, P. (Katolieke Univ., Louvain, Belg.). J. Nucl. Mater.; 43: No. 1, 51-8(Apr 1972).

The diffraction diagrams of the as cast U_3Si structure show unusual high peaks that have already been reported. An explanation of this phenomenon is given. A connection has been found between the x-ray diffraction results and the microstructural observations in respect of the orientation and morphology of the U_3Si_2 dendrites. (auth)

25971 DENSITY CHANGES IN ZIRCONIUM HYDRIDE RESULTING FROM FAST NEUTRON IRRADIATION. Paetz, P. (Interatom, Bensberg, Ger.); Luecke, K. J. Nucl. Mater.; 43: No. 1, 13-27(Apr 1972). (In German).

The behavior of δ and ε zirconium hydride under fast-neutron irradiation was investigated in four experiments at temperatures up to 580°C, using hydrogen analysis, measurements of density and dimensions, metallography, and x-ray diffraction. It was found that, quite independently of the method of examination, ε hydride can grow by 0.51%, in contrast to the irradiation-resistant cubic δ hydride. This growth is attributed to a radiation-induced change of the tetragonal structure which leads to an increase of the axial ratio. It was demonstrated that the volume growth of two-phase (δ + ε) specimens depends in a linear fashion on the ε contrast. (auth)

25972 FISSION GAS YIELDS FROM POROUS SINTERED BODIES. Exner, H. E.; Moench, S.; Petzow, G.; Lukas, H. L. (Max-Planck-Institut fuer Metallforschung, Stuttgart). J. Nucl. Mater.; 43: No. 1, 8-12(Apr 1972). (In German).

Using a simple model the conditions for stationary diffusion of fission gases to open pores in porous reactor materials are quantitatively formulated. It is shown that in reactors with high fluxes the fission gases are able to escape from fuel elements with a surface temperature of 1200°C if the pore distances are similar to those obtained under normal sintering conditions. In porous uranium phosphide with 18% open porosity there is no danger of swelling caused by fission gases even at high fuel burnup. (auth)

25973 THERMODYNAMIC PROPERTIES AND ELECTRICAL CONDUCTIVITY OF Ta_3N_5 AND TaON. Swisher, J. H.; Read, M. H. (Bell Telephone Labs., Murray Hill, N. J.). Met. Trans.; 3: No. 2, 489-94(Feb 1972).

TaON and Ta_3N_5 powders and thin films were prepared from Ta_2O_5 powders and tantalum thin films by equilibrating specimens with ammonia-bearing gas mixtures at 1100°K. TaON was found to be nonstoichiometric and to have semiconducting properties. The free energy of formation of $TaO_{1.05}N_{0.95}$, which is the composition in equilibrium with Ta_2O_5, is −94.1 ± 5 kcal per mole. The range of electrical conductivity observed at room temperature was 10^{-3} to 5 $(\Omega\text{-cm})^{-1}$. Ta_3N_5 has a free energy of formation of −65 ± 10 kcal per mole, and its electrical conductivity is 1.3×10^{-4} $(\Omega\text{-cm})^{-1}$. (auth)

25974 SYSTEM $Tl_2MoO_4–MoO_3$. Belyaev, I. N.; Doroshenko, A. K.; Nesterov, A. A. Zh. Neorg. Khim.; 16: No. 9, 2604 (Sep 1971). (In Russian).

A pyrometric study was made of the binary system $Tl_2MoO_4–MoO_3$, and the existence of five compounds was demonstrated: $Tl_2Mo_2O_7$, $Tl_2Mo_3O_{10}$, $Tl_2Mo_5O_{16}$, $Tl_2Mo_7O_{22}$, and $Tl_4Mo_3O_{11}$. The melting points (with decomposition) of the first four are, respectively, 426, 463, 550, and 583°C, and the fifth compound exists in the solid phase below 370°C. (K.S.W.)

25975 DEVELOPMENT AND APPLICATION OF SOLVENT EXTRACTION PROCESSES FOR THE PREPARATION OF $ThO_2–UO_3$ AND UO_2 SOLS. Ryon, A. D.; Finney, B. C.; McBride, J. P.; Parrott, J R. (Oak Ridge National Lab., Tenn.). pp 1142-9 of Proceedings of the International Solvent Extraction Conference. Vol. I and II London; Society of Chemical Industry (1971).

From International solvent extraction conference: The Hague, Netherlands (19 Apr 1971). See CONF-710417–(Vol.1 and 2).

Chemical flowsheets are presented for the preparation of $ThO_2–UO_3$ and UO_2 sols directly from aqueous solutions by extraction of nitrate with a long-chain amine in a hydrocarbon diluent. Both of these flowsheets have been scaled-up, and the reliability of each has been demonstrated by engineering tests in which several hundred kilograms of oxide as sol were produced. Sols prepared by solvent extraction were used to produce kilogram quantities of $ThO_2–UO_2$ ceramic microspheres containing ^{233}U and ^{235}U for tests of fuel for advanced nuclear reactors. The process for preparing $ThO_2–UO_3$ sol is continuous and involves a three-stage extraction of nitrate, with a digestion step between the first and second extraction stages. The UO_2 sol, on the other hand, is prepared by a batch process, which is carefully monitored for good control both during the feed preparation step, where U(VI) is reduced to U(IV), and during the subsequent sol preparation, where an operating curve involving time, temperature, and conductivity is important to the successful preparation of a highly crystalline product. (9 references) (auth)

25976 USE OF LANGMUIR METHOD FOR INVESTIGATION OF THERMODYNAMIC PROPERTIES OF REFRACTORY COMPOUNDS. Fesenko, V. V. (Inst. of Problems of Materials Behavior, Kiev). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1098-9(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 1929-31(Aug 1971).

Examination of published results and analysis of the Langmuir equation showed that evaporation from an open surface cannot be used to determine the equilibrium vapor pressure over refractory compounds either when molecules of the substance predominate over the solid phase or when congruent vaporization is accompanied by dissociation. Simple formulas are given for calculating coefficients of evaporation from thermodynamic data. (auth)

25977 THERMODYNAMICS OF THE HIGHER OXIDES OF TITANIUM AND VANADIUM. Vasil'eva, I. A.; Shaulova, E. Yu.; Sukhushina, I. S.; Shekhtman, S. N. (Moscow State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1141-3(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 2013-15(Aug 1971).

The partial thermodynamic functions of the oxide Ti_8O_{15} of the Ti_nO_{2n-1} homologous series have been investigated in the range 1148 to 1273°K by an emf method with a non-partitioned gas compartment over the electrode. The partial thermodynamic functions of the oxide V_6O_{11} of the V_nO_{2n-1} series have been investigated in the range 1200 to 1380°K by an emf method with a partitioned gas compartment. (auth)

25978 ANALYSIS OF THE PHASE EQUILIBRIA IN THE IRON–VANADIUM–CARBON SYSTEM. Mogutnov, B. M.; Tomilin, I. A.; Shvartsman, L. A. (Central Research Inst. of Ferrous Metallurgy, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1161-2(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 2047-8(Aug 1971).

Calculations have been made for the iron corner of the iron–vanadium–carbon equilibrium diagram at 1000°C from the activities of carbon and vanadium in austenite and the free energies of formation of vanadium carbide and cementite. The results have been compared with the experimental data. (auth)

25979 DISSOCIATION PRESSURE OF NIOBIUM NITRIDE (NbN) IN THE REGION OF HOMOGENEITY. Shchurik, A. G.; Tomilin, I. A. (Perm Polytechnic Inst., USSR. Central Research Inst. of Ferrous Metallurgy, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1162-4(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 2049-52(Aug 1971).

The equilibrium pressure of nitrogen over niobium nitride has been determined experimentally in the range 1250 to 1580°C as a function of the concentration of nitrogen in the range between 37 and 50 at. %. The results refer to the γ-phase of the niobium–nitrogen system. They have been subjected to a statistical treatment. (auth)

25980 SOLUBILITY OF CARBON IN IRON–NEODYMIUM–CARBON AND IRON–YTTRIUM–CARBON ALLOYS. Vasil'ev, V. V.; Burylev, B. P. (Metallurgical Inst., Novokuznetsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1167-9(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 2058-60(Aug 1971).

The solubility of carbon in liquid iron with added neodymium and yttrium has been investigated experimentally in a TVV-4 vacuum furnace in the range 1300 to 1550°C. The interaction coefficients and parameters have been estimated from the experimental results. (auth)

25981 X-RAY DIFFRACTION INVESTIGATION OF THE VANADIUM–DEUTERIUM SYSTEM. Hardcastle, Kenneth I. (San Fernando Valley State Coll., Northridge, Calif.); Gibb, T. R. P. Jr. J. Phys. Chem.; 76: No. 6, 927-30(16 Mar 1972).

A partial phase diagram for the vanadium–deuterium system was determined from an x-ray diffraction investigation of vanadium deuterides of overall composition $VD_{0.1}$ to $VD_{1.7}$. The system consists of three primary phases: α,β, and γ. The α, solid solution phase consists of mobile, interstitial deuterium in a body-centered cubic vanadium atom lattice. The β phase is characterized by a body-centered tetragonal metal atom lattice, and the γ phase has a face-centered cubic arrangement of vanadium atoms and presumably has the CaF_2-type structure. At room temperature the initial solid solution region (α) extends to $VD_{0.1}$. From $VD_{0.1}$ to $VD_{0.43}$ a two-phase region exists, α + β. Pure β phase exists in the composition range $VD_{0.43}$ to $VD_{0.53}$. Beyond $VD_{0.53}$ to $VD_{0.7}$ the second two-phase region occurs and contains the β phase and α phase—now with a much larger lattice parameter. Pure α phase exists at compositions from $VD_{0.7}$ to $VD_{1.0}$, whereupon the third two-phase region is encountered and consists of the α phase and the γ phase. Vanadium deuterides with compositions between $VD_{0.1}$ and $VD_{1.0}$ were also studied with x rays at higher and at lower temperatures. Above 130° only the α phase exists, while at lower temperatures two phase modifications were observed. The α′ phase, which has an orthorhombic lattice of vanadium atoms, results when samples of overall composition $VD_{0.5}$ to $VD_{0.8}$ are cooled to approximately −70° or below. This distortion of the cubic metal atom lattice results from the "freezing-out" of the previously mobile deuterium atoms. The other phase observed, β′, occurs when samples of overall composition $VD_{0.1}$ to $VD_{0.8}$ are cooled to −25° or below. This phase also has a bct lattice of vanadium atoms but a_0 decreases approximately 1% and c_0 increases approximately 3%. This is most likely due to additional ordering of the deuterium. (auth)

25982 THERMAL CONDUCTIVITIES OF URANIUM OXIDE AND OF MIXED URANIUM–PLUTONIUM OXIDES UP TO THEIR MELTING POINTS. Schmidt, H. E. (Europaeisches Institut fuer Transurane, Karlsruhe, Ger.). High Temp. - High Pressures; 3: No. 3, 345-53(1971). (In German).

Thermal conductivities of uranium oxide and of mixed uranium–plutonium oxides up to their melting points were computed from known specific heats and thermal conductivities below 1200°C. The good agreement between calculated and measured data suggests that the observed temperature variation of the thermal conductivity of UO_2 and of $U_{0.8}Pu_{0.2}O_{2-x}$ above 1200°C is essentially determined by the anomalous increase in the specific heat of these materials. (auth)

25983 IMPROVEMENTS IN OR RELATING TO THE PREPARATION OF MIXED OXIDES. Woodhead, James Louis; Dell, Ronald Michael; Junkison, Anthony Richard; Wilkinson, Raymond Westrop (to United Kingdom Atomic Energy Authority). British Patent 1,266,494. 8 Mar 1972. Filed 12 Mar 1968.

Reference is made to the preparation of ceramic materials of the type comprising mixed oxide compounds. Disadvantages of conventional processes for preparation are mentioned. The process described starts with an aqueous solution of salts of the appropriate metals in the required proportions, which is then dispersed in an inert organic liquid; this dispersion is mixed with a base soluble in the inert organic liquid, thereby causing gelling of the dispersed aqueous phase by hydrolysis. The salts and the base are selected so that the metal compounds in the gelled particles undergo, after separation and on heating, a solid state reaction to form the required mixed oxide compound. An organic base is normally employed and the solution is preferably added to the base. Nitrates are the preferred salts, and the ratio of acid anions to metal ions is not important. At least one of the components of the mixture should be capable of forming a hydrous oxide gel; suitable ions include rare earths, Th, U, Pu, Zr, Hf, Nb, etc. Chlorinated hydrocarbons, trichloroethane or kerosene are particularly suitable for forming the dispersion, and emulsifying or surface active agents may be added to aid dispersion and help control droplet size. Size control may also be effected by the manner of stirring. The organic base must be soluble in the suspending agent in order to give a single organic phase; a long chain aliphatic amine is suitable. Alternatively, NH_3 gas may be used. The gell spheres should normally be <50 μ to avoid segregation of the components during gelation; they are filtered from the organic phase, washed, and dried. After drying the particles are heated in the range 500 to 1000°C so that they partially react to form the mixed oxide compound, but are not fully sintered. In this state they are very reactive and little crystallite growth has taken place. The particles can be finely powdered and shaped into artifacts, possibly with addition of a binder, followed by fully firing to cause further sintering and crystalline growth. Alternatively the particles, after drying, may be fully sintered. Some examples are described. (UK)

25984 REDUCTION OF THORIUM OXIDE BY CARBON. Heiss, A.; Djemal, M. (Univ., Paris). Rev. Int. Hautes Temp. Refract.; 8: No. 3-4, 287-90(Jul 1971). (In French).

The reduction of thorium oxide by carbon was investigated in the 2000 to 2500°K range. The reaction was studied by establishing isotherms relating carbon monoxide pressures and the oxygen content of the samples. The reaction led to a univariant equilibrium between thorium oxide, carbon, thorium dicarbide, and carbon monoxide. The affinity and the heat of the reaction were calculated under standard conditions ΔH_{298}. An equation representing a slightly substoichiometric carbide is proposed, which satisfactorily accounts for the experimental results. (France)

25985 EFFECT OF W ON THE VAPORIZATION TEMPERATURE OF Eu_2O_3 ABOVE 1900°C. Petzel, Thomas; Greis, Ortw' 1 (Univ., Freiburg, i. B.). Rev. Int. Hautes Temp. Refract.; 8: No. 3-4, 269-76(Jul 1971). (In German).

The reactions of Eu_2O_3 and W at temperatures between 1900 and 2000°C in high vacuum led to the formation of a dark grey refractory phase having fcc symmetry and a lattice parameter of 5.395A or 5.378A, depending upon whether it was formed in equilibrium with excess Eu_2O_3 and W, or only with excess W. The composition of the phase in equilibrium with W can be approximately expressed by the formula: $Eu_{5.2}WO_{10.8-x}$. The vaporization behavior of Eu_2O_3 was studied at 2192 ± 10°K using the Knudsen effusion technique with a W cell. The average molar ratio of Eu/W was found to be approximately 3.7. Assuming the presence of EuO, Eu, W_3O_9, WO_3, WO_2, WO, O, and O_2 in the gas phase, calculations made for the enthalpy of formation and dissociation of EuO_3 at 0°K yielded values of −30 ± 2 and 131 ± 3 kcal/mole, respectively. (France)

25986 PREPARATION AND SOME PROPERTIES OF A BORON–ZINC COMPOUND. Korsukova, M. M.; Gurin, V. N.;

Kozlova, I. R.; (and others) (Ioffe Inst. of Physics and Tech., Leningrad). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 9, 1345-8(Sep 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 9, 1518-22(Sep 1971).

Studies on the B–Zn system showed that there is no true solubility of B in Zn. The dispersion of compact B in a Zn melt can be explained by a marked reduction in the free surface energy at the interface between the liquid Zn and solid B, resulting from adsorption, because, despite the absence of true solubility in the medium, the solid displays a tendency to quasispontaneous dispersion into particles, perhaps down to colloidal dimensions. A compound $B_{\sim 22}Zn$ was obtained, and its density and microhardness were measured. Results on the solubility of $B_{\sim 22}Zn$ in various reagents are listed. (P.C.H.)

25987 HIGH TEMPERATURE FURNACE FOR THE STUDY OF ThO_2–SrO AND ThO_2–BaO SYSTEMS. Fava, J. (Univ., Bordeaux); Le Flem, G.; Devalette, M.; (and others). Rev. Int. Hautes Temp. Refract.; 8: No. 3-4, 305-10(Jul 1971). (In French).

A high-temperature furnace was designed to facilitate the study of very high melting point oxides. ThO_2–SrO and ThO_2–BaO systems were studied and some of their properties were determined. (France)

25988 EFFECT OF OXIDE ADDITIVES ON THE SINTERING OF YTTRIA. Wurst, John Charles. Urbana, Ill.; Univ. of Illinois (1971). 167p. University Microfilms Order No. 72-7117.

Thesis.

Calcium flouride, calcia, baria, strontia, magnesia, silica, zirconium oxychloride, zirconia, and titania were screened in preliminary evaluations to determine if any of these compounds would inhibit discontinuous grain growth in yttria. On the basis of a microstructural evaluation, calcia, zirconia, and titania were selected for further study. Calcia additions were not effective. Grain growth was promoted rather than inhibited. Color centers were formed indicating that singly ionized oxygen vacancies formed to compensate for the negative charge produced by divalent for trivalent substitutions on the cation sublattice. Discontinuous grain growth was eliminated by the zirconia additions and fully dense specimens were obtained. Yttria–thoria systems also sinter to full density reportedly because of solute segregation. Zirconia additions should have behaved in a similar manner. However, no evidence of solute segregation was detected. As an alternate to the hypothesis of solute segregation, it was proposed that substitution of the tetravalent zirconium ion on the yttrium sublattice is accompanied by the formation of oxygen interstitials. These interstitials have little effect upon the self-diffusion of oxygen ions through the lattice but block paths for cation diffusion. Grain boundary migration in pure yttria is controlled by interstitial cation diffusion. When cation interstitial diffusion is sufficiently reduced by zirconia additions, it no longer controls the rate of grain boundary displacement. A vacancy flux from pores near and on grain boundaries is then controlling. Pores are dissipated rather than being trapped inside growing grains. Once these pores have been eliminated, the rate controlling step is cation diffusion by a vacancy mechanism and not the interstitial mechanism which prevails in pure yttria. The activation energy associated with grain growth in fully dense yttria–zirconia systems is nearly equal to that calculated for cation vacancy formation in yttria; thereby lending support to the hypothesis that cation vacancy diffusion is rate controlling in the later stages of grain growth in this system. Titania proved to be relatively insoluble in yttria. Limited phase equilibria studies indicated a maximum solubility at 2000°C of less than 3.0 mole percent with excess titania reacting to form a defect fluorite-type ternary compound. Titania in solid solution with yttria tended to promote grain growth and pore entrapment. The activation energy for grain growth was identical to that for pure yttria indicating an enhancement rather than a change in the predominant mechanism of material transport. With additions in excess of the solid solubility limit, the second phase which formed definitely affected grain growth. Grain growth curves indicated that coalescence of a second phase was taking place. This second phase also increased the activation energy for grain growth. (Diss. Abstr. Int., B)

25989 VAPORIZATION THERMODYNAMICS OF SAMARIUM DICARBIDE AND THULIUM DICARBIDE. Seiver, Robert Lane. East Lansing, Mich.; Michigan State Univ. (1971). 102p. University Microfilms Order No. 72-8777.

Thesis.

Several investigations of the vaporization of SmC_2 have been reported. The reported values of the equilibrium decomposition pressures are in only fair agreement and some workers report a variation in the enthalpy of decomposition of SmC_2 with the amount of free carbon present. A study was undertaken to examine this apparent composition dependence and to study the previously unreported vaporization of TmC_2. The dicarbides were prepared by direct combination of the elements under argon in sealed tantalum ampoules. Chemical analysis indicated that the products were generally metal-rich, $1.78 \leq C/M \leq 2.02$. X-ray powder diffraction patterns showed only the body centered tetragonal CaC_2-type structure for SmC_2 preparations and those TmC_2 preparations which were cooled quickly. Preparations of TmC_2 which were cooled slowly yielded the black low-symmetry modification previously reported. Preliminary single-crystal x-ray diffraction data indicate that this modification is actually a mixture of a hexagonal phase, $a = 3.19 \pm 0.01$ Å, $c = 16.74 \pm 0.07$ Å; and an orthorhombic phase, $a = 3.68 \pm 0.01$ Å, $b = 12.40 \pm 0.04$ Å, and $c = 13.58 \pm 0.03$ Å. The mixture quickly reverted to the tetragonal structure on heating in vacuum. Mass spectrometric observation of the effusate of TmC_2 vaporization with a 30 or 55 eV ionizing electron beam showed only Tm^+. Its appearance potential was 5.7 eV. Limits were set for carbide vapor species at $I_{TmC_2^+} < 0.005\ I_{Tm^+}$ and $I_{TmC^+} < 0.02\ I_{Tm^+}$. Vapor pressure measurements were made by target collection Knudsen effusion. The effusate was condensed onto chilled aluminum targets which were analyzed quantitatively by x-ray fluorescence. Metal-rich samples of SmC_2 or TmC_2 initially showed high erratic pressures. Calculations from weight loss data indicated that stable pressures were achieved very close to the $MC_{2.00}$ composition. Carbon-rich samples ($3 < C/M < 12$) showed the lower enthalpy previously reported, but this was found to be a time-dependent behavior. After several hours of heating the vapor pressures returned to the values measured over near-stoichiometric samples. It was determined that this initial behavior was due to oxygen contamination which results from hydrolysis by atmospheric water vapor. The oxide species are reduced by the excess carbon, releasing free metal. Vapor pressures over SmC_2 measured when oxygen contamination was absent were in good agreement with those reported by others who used methods unlikely to be seriously affected by oxygen contamination. The data from the three studies were combined to give for the pressure of Sm(g) over SmC_2(s),

$$\ln P_{Sm}(atm) = [(-31.5_{20} \pm 3_{00})/T] + (8.1_5 \pm 0.2_0) \quad (1)$$

over the temperature range 1400 to 2080°K. Vapor pressures of Tm(g) over TmC_2(s) measured when oxygen contamination was absent were fitted to the line

$$\ln P_{Tm}(atm) = [(-35.5_{70} \pm 3_{40})/T] + (8.9_8 \pm 0.1_8) \quad (2)$$

over the temperature range 1660 to 2130°K. Second law data reduction, carried out using heat capacities estimated from that of CaC_2, gave $\Delta H^0_{v\,298}$ (SmC_2) = $66._9 \pm 1._0$ kcal/gfw, ΔS^0_{298} (SmC_2) = $21._4 \pm 1._0$ eu; $\Delta H^0_{v\,298}$ (TmC_2) = $79._1 \pm 1._3$ kcal/gfw, ΔS^0_{298} (TmC_2) = $27._5 \pm 1._3$ eu. Third law calculations were made using the standard entropy of CaC_2 and Latimer's method; it was necessary to employ a nondegenerate ground electronic state for Tm^{+3} in TmC_2. This is in accord with the observation that TmC_2 does not undergo an antiferromagnetic transition at low temperatures. Results of the third law calculations were $\Delta H^0_{v\,298}$ (SmC_2) = $66._5 \pm 3._0$ kcal/gfw, $\Delta H^0_{v\,298}$ (TmC_2) = $78._7 \pm 3._0$ kcal/gfw. Thermodynamic calculations involving the reduction of sesquioxide by graphite indicate that the proposed effect of oxide contamination is feasible for SmC_2 and TmC_2. They further indicate that oxide contamination might interfere in the vaporization of HoC_2 and EuC_2, but not in that of any other lanthanide dicarbide. For SmC_2(s) and TmC_2(s), respectively, $\Delta H^0_{f\,298}$ are $-17._5 \pm 1._3$ and $-23._6 \pm 2._0$ kcal/gfw. (Diss. Abstr. Int., B)

25990 IMPROVEMENTS IN OR RELATING TO AGGLOMERATIONS OF COATED NUCLEAR FUEL PARTICLES. Gough, John Richard Cox; Sinden, Roland Perce; Meaden, Geoffrey William (to United Kingdom Atomic Energy Authority). British Patent 1,265,974. 8 Mar 1972. Filed 18 Dec 1968.

An improvement to BP 1,195,206 (12 Oct. 1967) is described. Nuclear fuel particles are formed into an agglomerate by first applying an overcoating of mixed resin and graphite powders in proportions 40 to 60% resin and 60 to 40% graphite by weight, vibrocompacting the particles in a vertical mold and continuing vibration during zone heating using a heater moved upwardly over the mold, while additions of fuel are made to avoid volume loss. The agglomerate may be removed from the mold for heat treatment or may undergo heat treatment in the mold, and the mold itself may comprise the containing part of the fuel element. Examples are described. The mold itself may be of annular cylindrical form, with a sleeve of polythene film applied around the inner surface before introducing the particles. (UK)

25991 HOT PRESSING OF TRANSIENT METAL OXIDES AND A STUDY OF THEIR PROPERTIES. Samsonov, G. V.; Koval'-

chenko, M. S.; Fen, E. K. (Inst. of Materials Development, Kiev). Phys. Sintering: 4: No. 1, 21-32(Jan 1972).

The examination of the hot-pressing process of transient metal oxide powders was performed and the dependence of the relative density on temperature, time, and pressure was established. It was found that densification of oxide powders can be described within the theory of the porous body bulk viscous flow. It was found that deformation rate of oxide powder particles during hot pressing submits to the law $\dot{\epsilon} \sim \sigma$, i.e., it is proportional to the stress. The activation energy values of the creep of oxide powder particles during hot pressing were established. The viscosity values for oxides at different temperatures were determined. It was found that viscosity decreases with the increasing temperature. The microhardness values of oxides obtained by the method of hot pressing are given. (auth)

25992 CRYSTALLOGRAPHIC STRUCTURE OF A NEW ω'(O) PHASE OBSERVED IN Ti–Zr–O ALLOYS. Dechamps, Michel; Dubertret, Alain; Lehr, Pierre (CNRS, Vitry-sur-Seine, France. Ecole Nationale Superieure de Chimie, Paris). Compt. Rend., Ser. C; 274: No. 5, 444-7(31 Jan 1972). (In French).

The Ti_2ZrO alloy, when annealed for a long time at low temperatures, presents an ω'(O) phase. Its orthorhombic lattice has the following parameters: a = 4.838 Å, b = 8.147 Å, c = 6.107 Å. Its structure is described in the Cmmm space group; the Wyckoff atomic positions are as follows: Ti in the 8n position, y = 0.338 and z = 0.254; Zr in the 2a and 2d positions; O in the 4e position. (France)

25993 VISCOSITY OF THE MELTS OF THE ZrO_2–MnO–SiO_2–Al_2O_3 SYSTEM. Mikiashvili, Sh. M.; Dzhincharadze, T. I.; Khomeriki, R. V.; Kekelidze, M. A. (Inst. of Metallurgy, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 65: No. 3, 649-52(Mar 1972). (In Russian).

The viscosity of oxide melts containing zirconium was determined by an electrorotary viscosimeter in the concentration range: 0 to 20% ZrO_2; 20 to 60% MnO; 20 to 50% SiO_2; and 5% Al_2O_3. Pseudotriple diagrams of viscosity for temperatures of 1600 and 1700°C were plotted. The activation energies of viscous flow and their dependence on the O/Si relation were determined. (auth)

25994 PREPARATION AND PROPERTIES OF PYROLYSIS OF VANADIUM OXIDE FILMS. Ryabova, L. A.; Serbinov, I. A.; Darevskii, A. S. (Inst. of Radio Engineering and Electronics, Moscow). J. Electrochem. Soc.; 119: No. 4, 427-9(Apr 1972).

Vanadium oxide films (V_2O_3, VO_2, V_2O_5) were obtained by the pyrolysis of vanadium acetylacetonate $(C_5H_7O_2)_4V$ in controlled atmosphere. The influence of deposition parameters on the film composition is studied. It was revealed that the composition of the gas carrier is the main factor determining the film composition. Electron diffraction and electron microscopy analysis of films are carried out. Temperature dependence of resistance was studied. VO_2 films deposited on glazed ceramic and sapphire change resistance by factor 10^3 at about 340°K. V_2O_5 films had an activated conductivity. (auth)

25995 PHASE EQUILIBRIA OF THE CHROMIUM–MOLYBDENUM–SILICON TERNARY SYSTEM. Marchiando, Peter Joseph. Urbana, Ill.; Univ. of Illinois (1971). 91p. University Microfilms Order No. 72-6995.

Thesis.

The investigation established the Cr–Mo–Si constitution diagram. All specimens which were used were prepared by either cold or hot pressing high-purity elemental powders. Liquidus and solidus temperatures were obtained using a Pirani type furnace. Isothermal sections were determined using x-ray and metallographic analysis of specimens which had been arc-melted and quenched prior to heat treatment. Chemical analysis was used to establish shifts in specimen composition after processing and evaluation. The Cr–Si and Cr–Mo systems were in good agreement with those reported in the literature. However, the Mo–Si system required major revisions from those previously proposed. The existence of two ternary compounds was established. The first occurs at 13 atomic % Si and forms in a peritectic reaction between the metal solid solution and the liquid. Its homogeneity range decreases with decreasing temperature. The compound disproportionates at 1375°C in a pseudo-binary eutectoid reaction forming (Cr, Mo) solid solutions and $(Cr, Mo)_3Si$ solid solutions. The second compound is stable to below 1000°C and exists between $(Cr, Mo_{0.14})Si_{0.72}$ and $(Cr, Mo_{0.27})Si_{0.72}$. The compound forms equilibria with all adjacent compounds. Quasi-binary systems are formed between Cr_3Si–Mo_3Si, Cr_5Si_3–Mo_5Si_3 and $CrSi_2$–$MoSi_2$. The Cr_3Si–Mo_3Si and Cr_5Si_3–Mo_5Si_3 systems form complete solid solutions. In the $CrSi_2$–$MoSi_2$ system, $CrSi_2$ forms in a peritectic reaction between $MoSi_2$ and the liquid. (Diss. Abstr. Int., B)

25996 INVESTIGATION OF INTERFACIAL EFFECTS ON THE MECHANICAL PROPERTIES OF ALUMINUM–BORON COMPOSITES. Chiang, James Cheng-hong. College Station, Tex.; Texas A and M Univ. (1971). 46p. University Microfilms Order No. 72-5643.

Thesis.

Heat treatment of a diffusion bonded 6061 aluminum-boron composite produces chemical reactivity at the interface which can be described by the conventional diffusion equation. The activation energy is 28,700 calories/gram-mole and the frequency factor is 1.6×10^{-3} cm²/sec. The ultimate transverse tensile strength of composite and 6061 aluminum metal sheet determines the contribution of the interfacial strength to mechanical properties. The greatest contribution is with a 1000°F heat treatment for up to 40 minutes. Increasing temperature or time will result in degradation of strength within the composite system. (Diss. Abstr. Int., B)

Metals and Alloys

25997 (AI-AEC-13021) FUELS, MATERIALS, COOLANT CHEMISTRY, AND FUEL HANDLING PROGRAMS. Quarterly Technical Progress Report, October–December 1971. (Atomics International, Canoga Park, Calif.). 15 Feb 1972. Contract AT-(04-3)-824. 91p. Dep. NTIS.

Research and development progress is reported on FFTF sodium component qualification, sodium cleaning, FFTF support work, radiation effects on fuel cladding and reactor core structural materials, cross-section measurements, Ta reactor control assemblies, fuel transfer machine components, and shield plug seals for LMFBR. (J.R.D.)

25998 (BNWL-668) REACTOR FUELS AND MATERIALS DEVELOPMENT PROGRAMS FOR FUELS AND MATERIALS BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY. Quarterly Progress Report, October–December 1967. Cadwell, J. J.; de Halas, D. R.; Nightingale, R. E.; Worlton, D. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar 1968. Contract AT(45-1)-1830. 193p. Dep. NTIS.

ADVANCED TEST REACTOR—gas loop for, development of
CALCIUM FLUORIDES—microstructure of powders and pellets of, sintered
CRYSTALS—radioinduced defects in, computer simulation of neutron
EDDY CURRENT TESTING—method for reactor fuels, development of
ENGINEERING TEST REACTOR—irradiation facilities in, operation of
EXPERIMENTAL BREEDER REACTOR II—neutron spectra in, activation foil measurement of
GAMMA RADIATION—effects on graphite–water reactions
GRAPHITE—oxidation by microwave-excited oxygen, microstructures produced by
—radioinduced reactions with water vapor, gamma
HAFNIUM—corrosion by pH 10 ammoniated water at 280°C, rates of
HASTELLOY X 280—radiation effects on creep of, at 1000°C, in-pile
INCONEL 600—stress rupture properties of, at 675°C
IRON—aging mechanisms in low-carbon, analysis of
—radiation effects on slip in, fast neutron
IRON 54—neutron reactions (n,p), cross section evaluation for fast reactor dosimetry
MOLYBDENUM—corrosion by pH 10 ammoniated water at 280°C, rates of
—corrosion by gases in ATR model loop
NEUTRONS—spectra of reactor, activation foil measurement of
NEUTRONS, FAST—effects on slip in iron
NIOBIUM—corrosion by pH 10 ammoniated water at 280°C, rates of
—corrosion by gases in ATR model loop
NIOBIUM ALLOYS AND SYSTEMS—Nb-base–Zr, corrosion by pH 10 ammoniated water at 280°C, rates of
—Nb–Zr-base, radiation effects on creep and tensile properties of, in-pile
PLUTONIUM NITRIDES—PuN–UN, radiation effects on properties of clad fuel pins of, in-pile
—PuN–UN, preparation by carbothermic reduction on tungsten supported particle-bed systems
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, microstructure of solid solutions of, electron microscopy studies of
RADIATION DETECTORS, ACTIVATION—performance of multi-foil, for measurement of fast reactor neutron spectra

REACTOR FUEL ELEMENTS—radiation effects on dimensional stability of thorium–uranium–Zircaloy, relations with burnup
—radiation effects on dimensional stability of hollow-core uranium, relations with burnup
REACTOR FUELS—compatibility of mixed nitride, with Type 304 stainless steel at 650 to 1000°C
SINTERING—mechanisms in fluorite-structured materials
STAINLESS STEEL—radiation effects on tensile properties of sodium-encapsulated specimens of Types 304 and 316, in-pile
—compatibility of Type 304, with bonded plutonium-nitride–uranium nitride fuels at 650 to 1000°C
STEEL—tensile properties of plates of Type A302B
TANTALUM—corrosion by pH 10 ammoniated water at 280°C, rates of
—corrosion by gases in ATR model loop
THERMAL TRANSFER TESTING—method for reactor fuels, development of
TITANIUM—corrosion by pH 10 ammoniated water at 280°C, rates of
TZM (MOLYBDENUM ALLOY)—corrosion by pH 10 ammoniated water at 280°C, rates of
ULTRASONIC TESTING—method for reactor fuels, development of
URANIUM NITRIDES—preparation by carbothermic reduction in tungsten supported particle-bed systems
URANIUM OXIDES UO_2—microstructure and fission product distribution in fuels of, effects of post melt cooling rates on
URANIUM OXYCARBIDES—electric conductivity at 1500°C
VANADIUM—creep at high temperatures, research programs on
WATER VAPOR—radioinduced reactions with graphite, gamma
ZIRCALOY-2—analysis of oxidized specimens of, for hydrogen, effects of degreasing on
—corrosion by pH 10 ammoniated water at 280°C, rates of
—radiation effects on creep of cold-worked, in-pile
ZIRCONIUM OXIDES—phase changes in, at high pressures, x-ray studies of (J.R.D.)

25999 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift mit Anhang Transplutonium-Elemente. Band 5, Heft 1-12. Jahresregister 1971. (Plutonium-Documentation. Abstract Journal with Appendix on Transplutonium Elements. Vol. 5, No. 1-12, 1971. Annual Index). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (1971). 230p. (In German and English).

26000 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift mit Anhang Transplutonium-Elemente. Februar 1972. Band 6, Heft 2. 158 Referate (Register-Nr.275-616), 71 Referate (Register-Nr.104T-174T). (Plutonium-Documentation. Abstract Journal with Appendix on Transplutonium Elements. February 1972. Vol. 6, No. 2. 158 Abstracts (Register No. 275-616), 71 Abstracts (Register No. 104T-174T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (1972). 119p. (In German and English).

26001 THORIUM. Woodmansee, W. C. Eng. Mining J.; 173: No. 3, 148-9(Mar 1972).

In 1971 the US Th supply, provided by one domestic monazite producer and by imported monazite and Th compounds exceeded industrial demand and resulted in growing stockpiles. However, research and development work on reactors, such as the LWBR, HTGR, and MSBR, using Th-U fuels and involving Th fuel reprocessing, and the construction of HTGR's by utility companies indicate increased demand for ThO_2. Little change is anticipated in Th prices and demand in the near future. Demand later in the decade will be influenced most significantly by the degrees of penetration of the nuclear energy market by the HTGR, which is now reaching the commercial stage. The long-range market will be determined to a large extent by the role of Th in the breeder reactor program. (L.C.L.)

26002 URANIUM. Sherman, J. T. (Atomic Industrial Forum Inc., New York). Eng. Mining J.; 173: No. 3, 140-3 (Mar 1972).

Uranium demand resulting from the growth of nuclear power is discussed with respect to the near-term and long-range outlook. Tabulated data are presented on US U reserves, production, and sales, and world resources. Factors which affect U demand such as enrichment capacity, supply of other energy sources, the environmental impact of U mining practices, and U production in countries outside the US are discussed. It is concluded that U prices will be depressed in the near future due to excess supply and the possible disposal of US government stocks as early as 1974, but the long-range forecast is for increased U demand. (L.C.L.)

Corrosion and Erosion

Refer also to abstracts 27330, 27382, 27388, and 27429.

26003 (CNLM–5178) COMPARISON OF PRETEST AND POSTTEST Cb–3Zr–0.35C RUN IN LITHIUM FOR 2000 HRS AT 2000°F. Geary, A. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 12 Jul 1963. Contract [AT(30-1)-2789]. 7p. Dep. NTIS.
Declassified 3 Nov 1971.

Examination of the sample before the tests revealed that a carbide precipitate was present along the work lines of the material. Globular carbide particles were scattered randomly throughout the entire sample. Needle-like particles were also seen throughout the sample. The yellow, carbide precipitates examined under polarized light revealed no birefringency. Therefore, their lattice structure is cubic, possibly being ZrC and/or NbC. Post-test examination revealed that the carbide phase in the sample did display some effects due to the liquid metal environment. However, no corrosion of the sample was observed. The transformation from a cubic to a non-cubic lattice structure of the carbide particles took place; the large globular carbide particles were optically active. During this transformation the migration of carbon also took place. The carbon on the surface of the sample was semi-continuous and sporadic. Associated with this carbon, on the surface of the sample, were dark gray areas. This gray phase was seen surrounding the carbide particles in the pretest sample. The carbide phase at the surface of the sample measured 0.7 of a mil. (auth)

26004 KINETICS OF NITRIDATION OF TITANIUM, ZIRCONIUM, AND VANADIUM AT TEMPERATURES BETWEEN 1100 AND 1500°C. Iyer, Subramanyam Kasinath. Philadelphia; Univ. of Pennsylvania (1971). 216p. University Microfilms Order No. 72-6172.
Thesis.

The kinetics of nitridation of strips (0.0254 to 0.0432 cm) of 99.97% titanium under one atmosphere pressure of nitrogen has been measured at temperatures between 1200 and 1450°C. The weight gain and the product layer thicknesses obey a parabolic rate law. Marker experiments established that the diffusivity of titanium is negligible in comparison with that of nitrogen. The intrinsic diffusivities of nitrogen in alpha titanium (hcp) and titanium mononitride at temperatures between 1200 and 1450°C are represented by the following respective equations

$$D_N(\alpha\text{-Ti}) = 0.25 \exp\left[-\frac{56{,}000 \pm 3200}{RT}\right] cm^2 \cdot sec^{-1}$$

and

$$D_N(TiN) = 0.58 \exp\left[-\frac{66{,}700 \pm 7000}{RT}\right] cm^2 \cdot sec^{-1}.$$

Nitridation experiments were also conducted on starting samples of nitrogen presaturated alpha titanium. The weight gain and product TiN layer thicknesses obey a parabolic rate law. The intrinsic diffusivities of nitrogen in TiN determined from these experiments were in excellent agreement with those determined from experiments on pure titanium. Nitrogen gradients on an alpha titanium nitrided at 1500°C for 404 minutes were measured using the electron microbeam probe analyzer. The results of these measurements are consistent with a vacancy mechanism for diffusion of nitrogen in TiN. The kinetics of nitridation of (0.0254 to 0.0508 cm) of 99.97% zirconium under one atmosphere pressure of nitrogen has been measured at temperatures between 1100 and 1500°C. The experimental results were similar to those observed for titanium. The intrinsic diffusivity of nitrogen in alpha zirconium in the temperature range of study can be represented by

$$D_N(\alpha\text{-Zr}) = 0.08 \exp\left[-\frac{53{,}100 \pm 2400}{RT}\right] cm^2 \cdot sec^{-1}.$$

The kinetics of nitridation of nitrogen presaturated alpha zirconium has been measured at temperatures between 1200 and 1500°C. The intrinsic diffusivity of nitrogen in zirconium mononitride determined from these experiments can be represented by

$$D_N(ZrN) = 3.12 \exp\left[-\frac{79{,}400 \pm 6000}{RT}\right] cm^2 \cdot sec^{-1}.$$

The kinetics of nitridation of vanadium subnitrile has been measured at temperatures of 1400 and 1500°C. The weight gain and

product V_2N layer thickness obeyed a parabolic rate law. The intrinsic diffusivities of nitrogen in V_2N at temperatures 1500 and 1400°C are respectively 2.41×10^{-8} and 0.65×10^{-8} $cm^2 \cdot sec^{-1}$. Nitrogen gradients in a V_2N sample nitrided at 1500°C for 117 minutes were measured using the electron microbeam probe analyzer. The results of these measurements are in accord with a vacancy mechanism for diffusion of nitrogen in V_2N. (Diss. Abstr. Int., B)

26005 CORROSION BY FLUORINATING AGENTS. Vincent, L. M. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 161, 17-31(Jul-Aug 1971). (In French).

Corrosion by fluorine and fluorinating products is of interest from both the technological and fundamental view points. Gas–solid reactions are considered, the experimental methods being reviewed. The reactions are divided into four categories, depending upon the fluorinating agent used: F_2, HF, ClF_3, UF_6; each category is reviewed. From a technical point of view, the corrosion of a metal depends essentially upon the properties of the interfacial layer of reaction products. Liquid–solid reactions are discussed (most of the technological data available concern such reactions). Gas–solid fluorination reactions are compared with dry oxidation reactions. Likely future developments are considered. (France)

26006 RELATIONSHIP BETWEEN THE STRUCTURE OF LEAD–CADMIUM ALLOYS AND CORROSION BEHAVIOR IN SULFURIC ACID SOLUTIONS. Bryntseva, V. I.; Dunaev, Yu. D.; Kir'yakov, G. Z. Tr. Inst. Khim. Nauk, Akad. Nauk Kaz. SSR; 24: 3-13(1969). (In Russian).

A study of the corrosion and anodic resistance of Pb–Cd alloys showed these to be determined by the electrochemical nature of Cd, which in the particular conditions does not form poorly-soluble oxidation products, and to be related to alloy structure (solid solution, eutectic). (14 references) (Corros. Control Abstr.)

26007 EFFECTS OF ENVIRONMENT ON MATERIAL PROPERTIES IN NUCLEAR SYSTEMS. Proceedings of the International Conference on Corrosion, London, July 1–2, 1971. Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971). 250p. £ 7.50. (CONF-710713).

Eighteen papers were presented, under the Session headings: zirconium alloys; stress corrosion cracking; liquid metals; and helium environments. Abstracts were prepared for 17. One paper on compatibility of ferritic steels with liquid sodium at high temperatures was previously included in NSA as 25: 49406. Discussions are included in the proceedings. (UK)

For abstracts of individual papers see: 26008–26020, 26088–26090, and 27429.

26008 CORROSION AND HYDRIDING OF ZIRCALOY-2 AND OTHER ZIRCONIUM ALLOYS IN BWRs. Garzarolli, F.; Diez, W.; Francke, K. P.; Fricke, W. (AEG–Telefunken, Frankfurt am Main). pp 15-20 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

Postirradiation measurements of oxide layers and hydrogen contents of Zircaloy-2 claddings of full size fuel elements of the German BWRs VAK, KRB, and KWL, which have been in operation for one to seven years, revealed that corrosion of the Zircaloy-2 was higher in-pile than out-of-pile. The hydrogen pick-up was only 3 to 7% of the theoretically possible value, and even after seven years of operation the net hydrogen content of claddings with 0.9 mm wall thickness was less than 100 ppM. In spite of varying heat fluxes of the fuel rods and different water chemistry of the reactors the over-all corrosion behavior of the claddings was very similar. The hydrogen pick-up seemed to be dependent on the oxide layer thickness and was locally higher at spots with spalled-oxides. Investigations of isothermal corrosion samples of Zircaloy-2, Zircaloy-4, Zr–Nb2.5 and Zr–Nb3–Sn1, which were inserted in the core of the VAK for one year, showed that the corrosion behavior of Zircaloy-4 is similar to Zircaloy-2, and that Zr–Nb2.5 has a very high in-pile corrosion rate in the oxygen-containing water of BWRs. The hydrogen pick-up of Zr–Nb3–Sn1 was lower than for the other alloys investigated. (auth)

26009 STRESS CORROSION CRACKING OF ZIRCONIUM ALLOYS IN IODINE VAPOUR. Garlick, A. (United Kingdom Atomic Energy Authority, Windscale, Eng.). pp 21-35 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

Failures in some water reactor fuel pins clad in Zircaloy-2 were found to possess many microstructural features in common with fractures produced during laboratory stress-corrosion tests on Zircaloy, and other zirconium alloys, in iodine atmospheres. This has led to the belief that under certain conditions fuel pin failures may result from fission product stress-corrosion cracking, the likelihood of failure being related to the design of the pin, the metallurgical condition of the cladding, and the mode of reactor operation. The importance of each of these factors is discussed and measures suggested by means of which the conditions conducive to this type of failure may be avoided. (auth)

26010 EFFECT OF ENVIRONMENT ON THE IN-PILE CORROSION AND HYDROGEN PICK-UP OF SOME ZIRCONIUM ALLOYS. Hurst, P.; Tyzack, C. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 37-49 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

During their service life the zirconium alloy pressure tubes in a reactor such as the SGHWR will undergo a certain amount of oxidation with concomitant hydrogen pick-up, both from the light water coolant and from the CO_2 vault gas atmosphere. Previous investigations have shown that the aqueous corrosion rate of Zircaloy-2 and the percentage of corrosion hydrogen absorbed by the material is affected by fast neutron irradiation, and also by the water chemistry. In a reactor the total hydrogen picked up in the lifetime of a pressure tube, and hence indirectly its mechanical properties, may be affected by the operational chemistry of the system. Two experiments of approximately 6 reactor cycles duration were carried out in an appendage of the DMTR Boiling Water Loop, one in neutral water, and one in neutral water with a hydrogen addition of ~1 ml/Kgm (simulating ammonia addition to the primary coolant in SGHWR) in order to compare the in-pile corrosion and hydrogen pick-up rates in different water chemistry conditions. Some specimens were also exposed to carbon dioxide and fast neutron irradiation in a vault gas simulation on the rig. Corrosion and hydrogen pick-up data are given for Zircaloy-2, Zircaloy-4, and 2½% Niobium–Zirconium alloy. (auth)

26011 STRESS CORROSION TESTING AND DESIGN CONSIDERATIONS RELATED TO THE USE OF AUSTENITIC STAINLESS STEELS IN BOILER PLANT. Ham, W. M.; Taylor, J. W.; Mellon, T. J.; McCarthy, P. J.; Perrin, A. J. (Babcock and Wilcox, Ltd., Renfrew, Scotland). pp 55-72 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

Stress corrosion and salt deposition studies were conducted on modern power plant materials under simulated steam raising conditions, with particular emphasis on the evaporation and steam dry-out zones in once-through units and on stress corrosion under supercritical conditions. Tests conducted with aggressive water chemistry conditions (high O_2 + acid chloride–$CaCl_2$) highlighted the evaporation/dry-out zone as being the danger area for stress corrosion attack and under these conditions both ferritic (9% Cr) and austenitic steels were susceptible to stress corrosion and pitting attack. Incoloy 800 did not crack but was subject to pitting attack. Deposition effects were generally in line with published solubility data, but with $CaCl_2$ hydrolysis was a complicating factor. Tests conducted under supercritical conditions indicated that stress corrosion of austenitic alloys was unlikely. Thin foil electron microscopy conducted on selected austenitic test specimens indicated that there was no simple relationship between dislocation array and stress corrosion susceptibility. In order to design out of the stress corrosion problem it is recommended that rigid water chemistry control be maintained and that special consideration be given to ensuring that austenitic materials do not come into contact with water during plant operation. (auth)

26012 REVIEW OF STRESS-CORROSION CRACKING EXPERIENCE IN WATER COOLED REACTORS. Berge, Ph. pp 73-8 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

The extensive use of corrosion-resistant austenitic alloys in water-cooled reactors had led to many incidents due to stress corrosion. It would seem that the risks of this type of corrosion were somewhat under-estimated previously. The purity of the primary water was thought to be an adequate guarantee, and an insufficient number of laboratory tests led to the conclusion that stainless steels were not susceptible to this form of attack. But from the entry into service of the first reactors, their operation has been impaired by a number of cases of corrosion cracking. Corrosion of an unknown type was found which could not apparently be explained by classical stress corrosion mechanisms in halogenous or caustic media. Available information on service failure of corrosion-resistant austenitic alloy and steel components due to the simultaneous effect of corrosion and mechanical stress is classified. (UK)

26013 STRESS CORROSION AND CONTROL OF THE WORKING ENVIRONMENT. Hearn, B.; Jones, D. de G.; Mann, G. M. W.; Masterson, H. G.; Newman, J. F. (Central Electricity Research Labs., Leatherhead, Eng.). pp 79-89 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

It has been assumed that stress corrosion requires the presence of a chemically aggressive liquid phase on the surface of a susceptible alloy. Experience on stress corrosion in the C.E.G.B. power plant is reviewed and the mechanisms are discussed whereby concentrated solutions of aggressive chemicals, particularly hydroxide and chloride, may form in evaporators, superheaters, and turbines. The relationship between the solubility of alloy constituents and stress corrosion in these concentrated environments is considered. Reports that high nickel alloys are susceptible to stress corrosion cracking in dry steam which is chemically very pure are discussed. (auth)

26014 STRESS ASSISTED CORROSION OF INCONEL 600 HEAT EXCHANGER TUBING IN HIGH TEMPERATURE WATER. Foster, G. G.; Taylor, J. W. (Babcock and Wilcox Ltd., Renfrew, Scotland). pp 95-110 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

Results are reported of a study over 10×10^3 h at 300 and 350°C of the stress-assisted intergranular sensitivity in high-purity water of specific tube components and casts of Inconel 600 to be used in a marine PWR system. Data are included on incubation times, crack propagation rates, effects of applied stress, metallurgical condition, etc., in both free-standing and crevice conditions. The data are then collated with related information from other sources to give a comprehensive and up-to-date assessment of those factors controlling intergranular attack of Inconel 600 in high pressure/high temperature water. (auth)

26015 INTERGRANULAR STRESS CORROSION CRACKING OF INCONEL X750 IN PRESSURISED WATER AT 300°C AND 350°C. Boisde, G.; Coriou, H.; Grall, L.; Mahut, R. (CEN, Fontenay-aux-Roses, France). pp 111-18 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

Inconel X 750 is sometimes selected for mechanical parts of pressurized water reactors (bolts for instance) and it seemed interesting to determine whether or not this material is liable to intergranular stress corrosion cracking in the same way as Inconel 600 alloy. Accordingly, traction and bending tests were conducted to study stress corrosion behavior of Inconel X 750, and the results were compared with those of Inconel 600, in high temperature demineralized water. Sensitivity of X 750 to intergranular stress corrosion cracking in pure water at 300 and 350°C was higher than that of Inconel 600. (auth)

26016 EFFECTS OF COMPOSITION AND OF STRUCTURE ON THE RESISTANCE TO STRESS CORROSION CRACKING OF STAINLESS STEELS. Truman, J. E. (Brown-Firth Research Labs., Sheffield, Eng.). pp 119-32 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

The susceptibility to stress corrosion cracking of various groups of stainless steels is described. The groups of steels are defined on the basis of microstructure. Composition of the steel is obviously important in establishing the basic microstructure which in itself is of great importance in establishing cracking behavior, but changes in composition which do not have an effect on structure can also have a marked effect on cracking resistance. (auth)

26017 CORROSION RATE AND MASS TRANSFER OF SELECTED AUSTENITIC AND FERRITIC STAINLESS STEEL IN HIGH TEMPERATURE SODIUM. Fevery, M. J. (SCK–CEN, Mol, Belgium); Wieling, N.; Casteels, F.; Libotte, P. pp 167-71 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

Test data which will permit material selection and evaluation of corrosion rate and mass transfer as a function of exposure time were analysed. Six austenitic alloys were included in the experiments. A dispersion-strengthened ferritic steel showed weight gain caused mainly by deposition and diffusion of nickel. (10 references) (auth)

26018 TRANSFER OF CARBON FROM AN INERT GAS CONTAINING CARBON MONOXIDE OR METHANE TO IRON AND NICKEL BASE ALLOYS. Antill, J. E.; Peakall, K. A.; Warburton, J. B. (Atomic Energy Research Establishment, Harwell, Eng.). pp 187-94 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

The carburisation of mild steels, low alloy steels, and highly alloyed materials in carbon monoxide and methane was examined at temperatures within the range 400 to 800°C, in the context of the compatibility of structural materials with a reactor coolant based upon helium. The most significant reactions were the deposition of carbon at low temperatures from carbon monoxide by the Boudouard reaction or a related reaction with hydrogen, and the reactions of highly alloyed materials with carbon monoxide and methane at temperatures $\gtrsim$800°C. Carburisation by methane was inhibited by oxide films and as a consequence may be most severe in crevices which cannot be penetrated by gaseous impurities of an oxidising character. (auth)

26019 BEHAVIOUR OF VANADIUM ALLOY CLADDINGS IN HELIUM COOLED REACTORS. Dorner, S.; Schumacher, G. (Kernforschungszentrum, Karlsruhe, Ger.). pp 195-202 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

Corrosion problems arising from the use of vanadium and its alloys in a helium-cooled reactor are discussed. Both the effects caused by impurities contained in helium and the reaction between uranium–plutonium oxide fuel and the cladding material were considered. The calculations indicated that a major deterioration of mechanical properties of the vanadium cladding can be expected due to the second of these effects at high burn-ups. (auth)

26020 INFLUENCE OF HTR HELIUM ON THE BEHAVIOUR OF METALS IN HIGH TEMPERATURE REACTORS. Huddle, R. A. U. (Atomic Energy Establishment, Winfrith, Eng.). pp 203-12 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

Following discussion of fundamental aspects of the interaction between HTR helium and metals and alloys, the results of experiments to study the nature and extent of this interaction are summarised. Although the total impurities may be less than 1 vpM the coolant is, from the corrosion point of view, best considered as a mixture of two parts hydrogen, one part carbon monoxide, with traces of methane, carbon dioxide, and water diluted with large quantities of helium. The work has resulted in an understanding of the phenomena involved, particularly those mechanisms that might lead to service failures, and should prove valuable in the selection of appropriate materials for the various duties envisaged. (auth)

26021 OXIDATION PROPERTIES OF U–16,6 AT. PERCENT Nb–5,6 AT. PERCENT Zr AND U–21 AT. PERCENT Nb. Cath-

cart, J. V.; Pawel, R. E.; Petersen, G. F. (Oak Ridge National Lab., Tenn.). Oxidation Metals; 3: No. 6, 497-521(Nov 1971).

The fundamental oxidation characteristics of two U-base alloys, U–16.6 at. % Nb–5.6 at. % Zr and U–21 at. % Nb, in the temperature range 500 to 1000°C in oxygen at 0.05 torr are described. Both alloys undergo large dimensional changes during oxidation at temperatures above 650°C due to stresses generated in the oxide during oxidation. Oxidation rate curves for both alloys were determined at 100°C intervals between 500 and 1000°C; the activation energy for the process was found to be small. The morphology of the oxide scale formed on the two alloys was complex and is described in detail. Stresses estimated at 10^6 psi were found to develop in oxidizing specimens, and a mechanism for the generation of these stresses is proposed. (auth)

26022 OXIDATION OF Ni–7.5 PERCENT Cr AND Ni–7.5 PERCENT Cr–2.5 PERCENT Sm_2O_3 AT 900 AND 1100°C. Stringer, J.; Hed, A. Z. (Battelle Labs., Columbus, Ohio). Oxidation Metals; 3: No. 6, 571-6(Nov 1971).

Studies were made on the effects of a dispersion of Sm_2O_3 on the oxidation of a Ni–7.5 wt % Cr alloy over a wide range of oxygen pressures. The results indicated that the Sm_2O_3 distribution has no effect on the oxidation process, and they were consistent with the mechanism of oxidation in the two alloys being exactly similar, and controlled by diffusion through the nickel oxide. It was also found that considerable difference in grain size had no effect either. (P.C.H.)

26023 EFFECT OF STRESS ON THE LOW-TEMPERATURE OXIDATION OF NIOBIUM. II. OXIDE WEDGE FORMATION. Weirick, L. J.; Larsen, W. L. (Ames Lab., Iowa). J. Electrochem. Soc.; 119: No. 4, 472-6(Apr 1972).

It was found that the formation of suboxide needles or plates, NbO_x, during the oxidation of niobium in the temperature range of 425 to 440°C was a function of initial specimen oxygen concentration, oxidation temperature, and applied tensile stress. It was further found that when the oxygen concentration at the substrate surface had reached an equilibrium level and the suboxide plates had formed, only a small tensile stress (less than 10,000 psi on low oxygen content niobium) was needed to form microcracks in a surface of the metal associated with these suboxide needles. Upon further oxidation these microcracks formed niobium pentoxide wedges penetrating the metal causing premature failure of niobium metal sheet. (auth)

26024 VERY PRECISE SECTIONING METHOD FOR MEASURING CONCENTRATION PROFILES IN ANODIC TANTALUM OXIDE. Pringle, J. P. S. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Electrochem. Soc.; 119: No. 4, 482-91 (Apr 1972).

Concentration profiles can be measured by removing thin uniform layers from the surface of a solid and determining the amount of the species left after the removal of each layer. The precision of such measurements depends on four factors: the thinness of the layers removed, the accuracy with which their thickness can be measured, the uniformity of the layers, and the accuracy with which the amount of the species present may be determined. A sectioning technique for anodic tantalum oxide, based on slow dissolution of the oxide in HF almost saturated with NH_4F, is described. Layers as thin as 5Å have been repeatedly and reproducibly removed, and the standard error in the total thickness removed is effectively about 3Å for the purpose of profile measurements. Furthermore, the layers are removed with extreme uniformity. In effect, therefore, anodic oxide films on tantalum can be sectioned almost atom layer by atom layer. (auth)

26025 EFFECT OF STRESS ON THE LOW-TEMPERATURE OXIDATION OF NIOBIUM. I. STRESSES INVOLVED IN THE OXIDATION PROCESS. Weirick, L. J.; Larsen, W. L. (Ames Lab., Iowa). J. Electrochem. Soc.; 119: No. 4, 465-71(Apr 1972).

Oxidation, cooling, dissolution, and annealing flexure measurements were performed on thin coupons of niobium presaturated with oxygen. Oxidation was done near 425°C in dry oxygen, dissolution in hydrofluoric acid, cooling and annealing in vacuum. From curvature measurements during each process, bending stresses were determined and correlated with oxidation rate and surface morphology. A thin-film model was applied to the bending due to niobium pentoxide formation. The resulting calculated compressive stress of about 123,000 psi agreed well with the known compressive strength of Nb_2O_5. Application of the thin-film model to an "effective" film of niobium suboxide gave compressive stresses of 125, 150, and 177 thousand psi for Nb_6O, Nb_3O, and Nb_4O, respectively, the reported formulas for NbO_x. Suboxide formation was found to cause bending during early stages of the oxidation process. An oxygen solution model did not adequately explain bending during early oxidation times for oxygen-presaturated niobium specimens. The resulting tensile stress on the substrate surface caused by oxidation was found to be significant, possibly approaching the yield stress. (auth)

26026 FIELD-DEPENDENCE OF THE DIELECTRIC CONSTANT DURING THE ANODIC OXIDATION OF TANTALUM, NIOBIUM, AND TUNGSTEN. Ord, J. L.; Hopper, M. A.; Wang, W. P. (Univ. of Waterloo, Ont.). J. Electrochem. Soc.; 119: No. 4, 439-45(Apr 1972).

In situ ellipsometric measurements on the galvanostatic oxidation of tantalum, niobium, and tungsten show that both the refractive index and the thickness of the oxide change suddenly on changing the current applied to the film. For all three metals the thickness was found to increase linearly with the electric field, whereas both the refractive index and low frequency (1000 Hz) dielectric constant were found to decrease linearly with increasing field. The magnitudes of the changes in dielectric constant and refractive index that were detected experimentally, when compared with theoretical predictions using standard dielectric theory and the observed change in thickness, indicate that these changes are due to the variation in the density of the film with the applied field. The inclusion of the linear dependence of the dielectric constant on field into an effective field model of the ionic conduction process is shown to be a possible explanation of the curvature in the plot of ln(i) vs. E for the anodic oxidation process. (auth)

Preparation and Fabrication

Refer also to abstract 25199.

26027 (DOCKET-701319–1) TEST AND RESEARCH REACTOR FUEL ELEMENT FABRICATION PLANT. Environmental Report. (U. S. Nuclear, Inc., Oak Ridge, Tenn.). Mar 1972. 42p. Dep. NTIS.

Information is included on the site prior to use, description of the plant, environmental impact of site preparation and plant construction, environmental impact of plant operation, unavoidable effects of plant construction and operation, resources committed in plant construction and operation, environmental approvals and consultations, and alternatives to construction and operation of plant and cost-benefit analysis. (P.C.H.)

26028 (SC-DC–721128) ION PLATING: CONCEPTS AND APPLICATIONS. Mattox, D. M. (Sandia Labs., Albuquerque, N. Mex.). [1971]. 36p. (CONF-720308–1). Dep. NTIS.

From NASA technology utilization conference on sputtering and ion plating; Cleveland, Ohio (16 Mar 1972).

The term ion plating is applied to atomistic deposition processes in which the substrate is subjected to a flux of high-energy ions sufficient to cause appreciable sputtering before and during film deposition. From the standpoint of adhesion, the principal benefits obtained from ion plating include ability to sputter clean the surface and maintain it "clean" until the film begins to form; provide a high-energy flux to the substrate surface giving a high surface temperature without necessitating bulk heating, thus enhancing diffusion and chemical reactions; and alter the surface and interfacial structure by introducing high defect concentrations, physically mixing the film and substrate material, and influencing the nucleation and growth of the depositing film. The fundamental concepts of ion plating are outlined along with relevant studies in other areas. The ion plating process is also discussed in terms of equipment and techniques. Specific applications are described which include: formation of contacts to semiconductors, corrosion protective coatings for reactive materials in severe environments, and low secondary electron emission coatings on complex shapes. It is shown that ion plating is particularly effective in obtaining good adhesion in metal systems where conventional techniques give poor results. A comprehensive bibliography of ion plating and related technologies is appended. (auth)

26029 PREPARATION OF THE RARE EARTH METALS USING A VACUUM METALLOTHERMIC REDUCTION. de Gasquet, J. (Trefimetaux, Paris); Rolland, P.; Marcel, P.; Rapin, G. Vide; 26: No. 153, 114-17(May 1971). (In French). (CONF-710451–1).

From Meeting on the application of vacuum techniques in chemical engineering and metallurgy; Paris, France (19 Apr 1971).

Methods of producing very high-purity rare earths have been developed, both on the laboratory and the industrial scale. Two methods of reduction have been particularly developed; both are applied under vacuum. Metallothermic reduction of the oxide followed by vacuum distillation is used for volatile metals, such as Sm, Eu, and Yb. Calciothermic reduction of the fluoride in the presence of Mg is used for the remaining metals. The Ca and Mg contained in the alloy are then distilled. The first pro-

cedure is described in detail; distillation under vacuum or fusion under vacuum is generally necessary to purify the metal. (France)

26030 PROCESS FOR JOINING Nb AND STAINLESS STEEL PARTS: AN APPLICATION. Aujollet, Jean-Marie; Pellissier, Henri; Sionnet, Jean; Vere, Bernard (to Commissariat a l'-Energie Atomique). French Patent 2,067,655. 26 Jul 1971. Filed 12 Nov 1969. (In French).

Niobium and stainless steel are materials being used increasingly in nuclear reactors and other devices operating in highly radioactive environments because of their desirable mechanical properties at high temperatures. A process for joining parts made of Nb and stainless steel is described. It involves placing an intermediate material (a steel containing a large quantity of Ni) in contact with the Nb, heating the surfaces to be joined under secondary vacuum until a eutectic is formed between the Nb and the Ni by the diffusion of the Ni in the Nb, leaving the assembly to cool, and then welding the stainless steel onto the intermediate material. (France)

26031 REMOVAL OF NITRATE CONTAMINATION FROM NICKEL-PLATING SOLUTIONS. Knight, James T.; Lee, Parley L. (to United States Atomic Energy Commission). U. S. Patent 3,640,805. 8 Feb 1972. Filed 13 Jun 1969.

A method for purifying the nickel plating bath used for plating uranium slugs is described. A nitrate-contaminated nickel plating bath is purified by heating the bath to between 65 and 70°C, agitating the bath and electrolyzing the bath while providing a 10 to 20 fold greater cathode area than anode area. (Official Gazette)

26032 EFFECT OF VAPOUR INCIDENCE ANGLES ON PROFILE AND PROPERTIES OF CONDENSED FILMS. Nakhodkin, N. G.; Shaldervan, A. I. (Kiev State Univ.). Thin Solid Films; 10: No. 1, 109-22(Apr 1972).

The profile of evaporated polycrystalline and amorphous films of various materials has been investigated as a function of condensation conditions: angle of vapor incidence, substrate temperature, and residual gas pressure. In most cases at oblique vapor incidence, films are shown to consist of needle-like formations or columnar crystallites. The crystallites are inclined to the substrate and the angle of inclination ϕ is defined by the condensation conditions. In oblique columnar structure formation, the processes of surface self-diffusion are important. Attention is given to the existence of needle-like formations in amorphous films of Ge, Si, and GeTe. (auth)

26033 METHOD FOR OBTAINING A METAL COATING AND METALLIZING MIXTURE COMPOSITION. Karlak, R. F. (to Lockheed Aircraft Corp.). Swedish Patent 309,191. 10 Mar 1969. Filed 23 Aug 1967.

A method is described for obtaining coatings of Ti, Zr, Hf and U on glass, quartz, beryllium, ceramics, and porcelain. A mixture containing halides of alkali and alkali earth metals, metal (Ti, Zr, Hf, U) particles less than 0.053 mm in diameter and water, in the form of a suspension, is applied by means of an atomizer or by some other method at 93 to 149°. After application, the coating is heat treated in a controlled nonoxidizing atmosphere at 649 to 871°, treatment time being sufficient to ensure fusion of the salts, sintering of metal particles, and formation of a coating. The resultant coating consists of a thin dense metal layer bonded to the substrate and a second porous layer attached to the first. This method is economic, gives a high quality bond between coating and substrate, and can be used for hard soldering of ceramics, vacuum seals, and for production of printed circuits and integral electronic parts. (Corros. Control Abstr.)

26034 COMPOSITIONAL CONTROL OF TANTALUM–ALUMINUM ALLOY FILMS BY A dc-BIASED, ac SPUTTERING TECHNIQUE. Steidel, C. A. (Bell Telephone Labs., Inc., Allentown, Pa.); Jaffe, D.; Kumagai, H. Y. J. Vac. Sci. Technol.; 9: No. 1, 346-9(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

The deposition of a wide range of controlled compositions from a fixed electrode and substrate geometry is demonstrated for Ta–Al alloy films using a unique dc-biased 60-Hz ac-sputtering technique. Sputtering takes place from sets of water-cooled Ta and Al tubular rods which alternate as anode and cathode during a high-voltage ac cycle. Alloy compositions over the range of 72 to 5 at. % Al were obtained by systematically varying a series dc bias applied to the Ta rods from 0 to –1600 V. Reproducibility at a given bias voltage was found to be approximately ±3 at. % Al. Possible mechanisms by which the dc bias affects film composition are discussed. (auth)

26035 FAST ROTATION TECHNIQUE FOR THE FORMATION OF A THIN-FILM INTERMETALLIC COMPOUND ON A CYLINDRICAL METALLIC SUBSTRATE. Meyer, C. H. Jr.; Merriam, Marshal F.; Snowden, D. P. (Gulf General Atomic Co., San Diego, Calif.). J. Vac. Sci. Technol.; 9: No. 1, 354-6(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

A technique has been developed that allows a uniform stoichiometric thin-film compound to be formed on the outer surface of a cylindrical substrate by rapidly rotating the substrate about its longitudinal axis so that the thickness of approximately one lattice constant is deposited per revolution. Niobium and tin were vacuum evaporated simultaneously from separate sources, and bulk quality Nb_3Sn films were formed over the complete substrate surface. In addition, samples were prepared of alternate layers of Nb_3Sn and a second material with sharp delineation between layers. Some of the technology necessary for this method of film preparation is discussed. (auth)

26036 STRUCTURE MODIFICATION BY ION BOMBARDMENT DURING DEPOSITION. Mattox, D. M.; Kominiak, G. J. (Sandia Labs., Alburquerque, N. Mex.). J. Vac. Sci. Technol.; 9: No. 1, 528-32(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

It is shown that continuous or intermittent ion bombardment during deposition can change the growth mode of thick deposits formed by sputtering or evaporation. The columnar morphology commonly found when deposits exceed 1 μ in thickness can be disrupted and the deposit densified by negatively biasing the deposit and subjecting it to ion bombardment during growth. This effect is found to occur in a number of metal systems and may be attributed to resputtering during growth. In the case of sputter-deposited tantalum, the density of 6-μ thick films can be increased from 14 g/cm^3 at 0 deposit bias to 16.3 g/cm^3 at –500-V bias. The macroscopic stress in the deposited film is also shown to be a function of the deposit bias. It is proposed that this growth habit modification may also be obtained in sputter-deposited nonmetallic materials and chemical vapor deposits by ion bombarding the deposit during growth. (auth)

26037 WELDING PROBLEMS IN NUCLEAR ENERGY. Wyatt, L. M. (Central Electricity Generating Board, London). Aust. Weld. J.; 16: No. 1, 7-11(Jan-Feb 1972).

A summary of welding techniques used in reactor pressure vessels and fuel elements is presented. In Magnox fuel elements calcium was eliminated after it was found responsible for weld cracking. A He filling device was introduced to facilitate heat transfer from bar to can and to test weld soundness by leak indication. Electron beam welding was found to provide a more robust weld but the failure rate of end welds has been so low as to obviate the necessity of a changeover. A pressed end cap inserted in the can was used for AGR fuel elements. Gas shielded arc welding proved highly satisfactory as a seal weld but a resistance seam weld was also provided to give protection against shear forces. A variety of methods has been used in water cooled power reactors but generally the gas shielded method prevails. Magnetic force resistance welding was utilized in SGHWR reactor fuel elements. Pressure vessel welding in gas cooled reactors was carried out either by automatic submerged arc or manual metal arc. High control standards were implemented and greatly restricted subsequent problems. Two serious failures are analyzed. Some stress analysis procedures are discussed for water reactors and progress with inherent problems is considered. (Australia)

26038 REDUCED SPUTTERING YIELDS FOR TWO-PHASE Ag–Ni AND Ag–Co TARGETS. Dahlgren, S. D.; McClanahan, E. D. (Battelle-Northwest, Richland, Wash.). J. Appl. Phys.; 43: No. 4, 1514-17(Apr 1972).

Sputtering yields of water-cooled two-phase Ag–Ni and Ag–Co targets were found to be much lower than predicted by averaging the yields of the unalloyed metals. The target yields steadily decreased when the Ni or Co content increased from 0 to 30 at. %. Above 30 at. % Ni or Co, the yields did not change and were equal to the respective yields for Ni and Co. Thus, the results indicate that yields may be predictable for some multiphase targets from the yield of the low-yield phase. The unusually low yields were attributed to coating of the high-yield Ag phase with lower-yield Ni or Co during sputtering. Simultaneous coating and sputtering processes reached steady state before removal of 20 μ from freshly prepared nonpresputtered Ag–Ni targets, even though Ni particles were up to 130 μ in diameter. Quantitative microprobe analysis of one Ag–Ni deposit indicated deposit compositions were nearly the same as target compositions. (auth)

26039 APPLICATION OF THE METHOD OF SINTERING TO THE ANALYSIS OF BORIDES (EXCHANGE OF EXPERIENCE). Kugai, L. N.; Nazarchuk, T. N. (Inst. of Problems of Material Science, Kiev). Ind. Lab. (USSR) (Engl. Transl.); 37: No. 9, 1340(Sep 1971).

Translated from Zavod. Lab.; 37: No. 9, 1053-4(Sep 1971).

The decomposition of borides of the transition metals by the method of sintering with barium carbonate or calcium oxide has been used for the borides of titanium, zirconium, chromium, and molybdenum. A further verification of this method indicated that borides of the stoichiometric composition are not entirely decomposed by these reagents. Mixtures of sodium carbonate with calcium oxide in a 1 : 2 ratio and of barium carbonate with calcium oxide in a 1 : 1 ratio were sintered for the decomposition of the borides of titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum, and tungsten. A weighted sample of boride with a grain size 10–15 μ was mixed with a 10-fold amount of the indicated mixtures, transferred to a porcelain crucible, the bottom of which was preliminarily coated with the same mixture. The crucible with weighed sample was placed in a muffle furnace and kept at 800 to 900°C from 30 to 60 min. The sinter cake was poured out into a beaker, dissolved in hydrochloric acid, the excess acid neutralized with alkali, and metal hydroxides precipitated from the weakly acid solution with barium carbonate or calcium oxide. After removal of the hydroxides, the filtrate was acidified with hydrochloric acid according to methyl red, boiled to remove carbon dioxide, and boron determined by a volumetric method in the presence of mannitol. The dependence of the completeness of the decomposition of borides by various mixtures on the time of sintering for the temperatures 800 and 900°C was studied. In all cases the weight of the boride sample for sintering was 0.1 g. Sintering of borides with calcium oxide was also performed for comparison. All the borides decompose entirely when sintered with a mixture of sodium carbonate and calcium oxide at the temperatures 800 and 900°C for 30 min. In the case of sintering with a mixture of barium carbonate and calcium oxide, all the borides (except for chromium boride) decompose entirely at 800°C within 1 h, and at 900°C within 30 min. The time of sintering for chromium boride at 800°C is 4 to 5 h, and at 900°C it is 1 h. Sintering with calcium oxide does not entirely decompose all borides at 800°C. At 900°C the time of complete decomposition of all the borides, with the exception of chromium boride, is 1 h; chromium boride is decomposed by sintering with calcium oxide for 3 h. (auth)

26040 WELDABILITY OF NICKEL-BASE HEAT RESISTING SUPERALLOY IMPROVEMENT OF HOT CRACKING SENSITIVITY OF INCONEL 713 C AND ITS MECHANICAL PROPERTIES. Ikawa, Hiroshi; Shin, Shigeo; Nakao, Yoshikuni (Osaka Univ.). Technol. Rep. Osaka Univ.; 21: 461-74(Oct 1971).

The hot cracking sensitivity of Inconel 713C is decreased with increasing C content or decreasing Al content. However, increasing C content (adding 0.2 to 0.3%C) is better than decreasing Al content, when emphasis is put on creep rupture properties. (auth)

26041 FUNDAMENTAL STUDIES ON POWDER PARTICLE BEAM MACHINING BY ELECTROSTATIC ACCELERATION. Tsuwa, Hideo; Aketa, Yuzo; Ide, Takashi; Tatekawa, Masaichiro (Osaka Univ.). Technol. Rep. Osaka Univ.; 21: 671-89(Oct 1971).

In order to develop a new method of powder particle beam machining, an approach to give the powder particles a large amount of charge is made by contacting powder particles with an electrode maintained at high potential, or by contact charging. The charging mechanism is theoretically analyzed by the image method for the contact model of two spheres, so that the correlation between the surface electric fields on both spheres is expressed only in terms of the ratio of sphere radii. The theory is experimentally justified by a model experiment using the steel spheres of several millimeters in size. Further, it is experimentally proved that the amount of charge yielded by field emission is the same as by the contact charging. The charging of tungsten powder particles is made with the needle or the fine wire electrode and the amount of charge is measured with a Faraday cage. The maximum amount of charge on powder particle of 0.5μ diameter becomes 1.6×10^3 times of electronic charge and its surface electric field strength is 2×10^7 V/m. This result may signify that the powder particle attains the kinetic energy of 1.6×10^3 times of an electron accelerated under the same potential difference and the velocity of the powder particle may reach to 240 m/sec at the accelerating voltage of 100 kV. This suggests the possibility of powder particle beam machining. (auth)

26042 PROCESSING STEELS FOR NUCLEAR PRESSURE VESSELS. Miyano, Katao; Shimazaki, Masahide (Japan Steel Works Ltd., Muroran). Metal Progr.; 101: No. 4, 97; 101-2 (Apr 1972).

Processing methods for A533, A302, A508, and A516 steels for pressure vessels are described. Information and data on electric furnace and vacuum processing methods are discussed along with rough forging used to improve properties. (J.R.D.)

26043 TUNGSTEN NEWS, APRIL 1972. Tungsten News; 1-18(Apr 1972).

A review is presented concerning developments in tungsten technology during the month. Information and data are included on tungsten metal, tungsten carbide, tungsten-base alloys, recovery and processing, and tungsten compounds. 353 references are included. (J.R.D.)

26044 VACUUM INDUCTION HEAT TREATMENT OF LONG TUBULAR PRODUCTS. (to Canadian Westinghouse Co. Ltd.). British Patent 1,268,988. 29 Mar 1972. Priority date 29 Sep 1969, Canada.

A vacuum induction heat treatment apparatus is described for long tubular reactive metal products. The equipment is relatively inexpensive and use of the method does not promote work hardening. The method is convenient and affords homogeneous heating. (J.R.D.)

26045 PREALLOYED POWDERS AND OXIDE-FREE TOOL AND STRUCTURAL ALLOYS. (to IIT Research Inst.). British Patent 1,269,407. 6 Apr 1972. Priority date 11 Jul 1968, United States.

Heat-resistant Cr-free compositions suitable for powder metallurgy consolidation into oxide-free stock used in cutting tools, dies, and wear parts are described. Methods used in powder production for use in these processes are also described. The weight content of the alloy is 0.5 to 4.0% C, 0 to 60% W, 0 to 60% Mo, and the remainder being Fe, Ni, or a mixture of these. (J.R.D.)

26046 METHOD OF PREPARATION OF METALS IN THE MASSIVE STATE FROM THEIR OXIDES. Gallay, Jean-Jacques; Helary, Jean-Louis; de la Graviere, Marcel Jurien (to Commissariat a l'Energie Atomique). British Patent 1,269,029. 29 Mar 1972. Priority date 11 Jul 1969, France.

A pyrochemical process is described for preparation of metal ingots by direct reduction of the oxide without passing through an intermediate compound. The apparatus for the process is also described. The method and equipment are particularly well suited to conversion of enriched UO_2 to U. (J.R.D.)

Properties, Structure, and Phase Studies

Refer also to abstracts 25437, 25505, 25980, 27309, 27311, 27321, 27323, 27324, and 27339.

26047 (AD–733937) FIELD ION MICROSCOPE OBSERVATION OF IRON-BASE–TUNGSTEN ALLOYS. French, Robert D. (Army Materials and Mechanics Research Center, Watertown, Mass.). Aug 1971. 20p. (AMMRC-TR-71-22). NTIS.

A field ion microscope investigation was carried out for low-solute content iron base-tungsten alloys. These alloys had previously demonstrated an etching effect that was postulated to be the result of solute atom ordering. The investigation did not reveal ordering of the solute atoms, although a second etching effect was demonstrated. Specimen preparation for the field ion microscope produced a twin in one sample. The twin was analyzed for shape and boundary structure. Results are contrasted with earlier observations. (auth) (NTIS)

26048 (AWRE-O-5/72) TENSILE PROPERTIES OF HOT PRESSED BERYLLIUM: EFFECT OF STRAIN RATE ON PROPERTIES UP TO 1100K. Turner, G. I.; King, E. G. (Atomic Weapons Research Establishment, Aldermaston (England)). Jan 1972. 18p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

For the strain rates 4×10^{-4}, 2.5×10^{-3}, and 5×10^{-1} s^{-1} in 100% dense beryllium the variation of the ultimate tensile strength (UTS), fracture stress, and reduction of area with temperature, in the range 300 to 1100°K, are presented and analyzed. Within this temperature range both the UTS and the fracture stress were increased up to eight fold by raising the strain rate from 4×10^{-4} to 5×10^{-1} s^{-1}. For a constant strain rate a maximum was observed in the curve of reduction of area versus temperature. The effects of increasing the strain rate were to raise the temperature at which the maximum occurs and to slightly reduce the peak value of the reduction of area. The UTS and fracture stress were functions of the temperature compensated strain rate (TCS) which is given by TCS, $\dot{\epsilon}_{TC} = \dot{\epsilon}e\ (\Delta H/RT)$. The best fit value of the activation energy for both the UTS and fracture stress was approximately 41000 cal. It is proposed that the TCS characterizes the mode of failure and this premise is applied to the brittle/ductile transition. (auth)

26049 (AWRE-O-17/72) FRACTURE TOUGHNESS OF BERYLLIUM: A SUMMARY OF THE PRESENT STATE OF KNOWLEDGE. Cooper, R. E. (Atomic Weapons Research Establishment, Aldermaston (England)). Jan 1972. 40p. Dep. NTIS (U. S. Sales Only). UK 1.00 pound.

Work on the plane strain fracture toughness behavior of beryllium was surveyed and compared with data obtained by the author. The effects of specimen preparation, testing procedure, heat treatment, test temperature, strain rate, and environment were examined for both ingot material and fully dense and porous hot pressed powder material. It was found that the plane strain fracture roughness of beryllium lies in the range 8 to 20 kpsi $\sqrt{1}$ and that it is not very sensitive to heat treatment, strain rate, or environment. Porosity, however, has a considerable effect on toughness with a maximum toughness being attained at about 5% porosity. Possible reasons for this are discussed. Beryllium was compared with other structural metallic materials in terms of strength and fracture resistance. Suggestions for further research are also made. (31 references) (auth)

26050 (BBC-106) DEVELOPMENT OF INTERMETALLIC COMPOUNDS FOR VERY HIGH-TEMPERATURE APPLICATIONS. Progress Report No. 1, November 1, 1959–January 31, 1960. Paine, R. M.; Stonehouse, A. J.; Beaver, W. W. (Brush Beryllium Co., Cleveland, Ohio). 31 Jan 1960. Contract AT(30-1)-541. 27p. Dep. NTIS.

Declassified 28 Oct 1971.

Progress in the development of intermetallic compounds between beryllium and the transitional elements is described. Studies have shown that $GdBe_{13}$ forms a solid solution with $ZrBe_{13}$ and that compositions containing 10 wt % gadolinium are comparable in oxidation resistance to $ZrBe_{13}$ at 2500°F and somewhat less resistant at 2700°F. The modulus of rupture of such material at 2300° is about 50,000 psi and at 2500°F is about 47,000 psi. Mixed-phase compositions of the M_2Be_{17}–MBe_{12} type in the niobium–beryllium system have shown moduli of rupture of 70,000 psi at 2300° and 60,000 psi at 2500°F. Work is continuing on the effect of purity on the properties of the compounds and fabrication by ceramic techniques. (auth)

26051 (BBC-107) DEVELOPMENT OF INTERMETALLIC COMPOUNDS FOR VERY HIGH-TEMPERATURE APPLICATIONS. Progress Report No. 5, February 1–April 30, 1960. Paine, R. M.; Stonehouse, A. J.; Beaver, W. W. (Brush Beryllium Co., Cleveland, Ohio). Jul 1960. Contract AT(30-1)-541. 47p. Dep. NTIS.

Declassified 28 Oct 1971.

Progress in the development of intermetallic compounds between beryllium and certain transitional elements for high-temperature applications is described. Studies of compositions intermediate between the M_2Be_{17} and MBe_{12} or MBe_{13} compounds within a particular binary system have indicated that substantial strength improvement over single-phase preparations is realized in most instances. Substantial increases in ability to plastically deform at elevated temperatures were also observed for these intermediate compositions. A new phase in the Nb–Be system with a composition approximating Nb_2Be_{19} was also observed. Initial investigations of moduli of rupture at room temperature, 800, 1600, and 2100°F have shown minimum modulus-of-rupture values at 1600°F for both $NbBe_{12}$ and $ZrBe_{13}$. Continuing work on the purity of intermetallic compounds is also described, as well as efforts to develop procedures to fabricate intermetallic compounds by standard ceramic techniques such as cold pressing and sintering. (auth)

26052 (BBC-110) DEVELOPMENT OF INTERMETALLIC COMPOUNDS FOR VERY HIGH-TEMPERATURE APPLICATIONS. Quarterly Progress Report, January 1–March 31, 1961. Owens, L.; Paine, R. M.; Stonehouse, A. J.; Beaver, W. W. (Brush Beryllium Co., Cleveland, Ohio). 15 May 1961. Contract AT(33-3)-20. 31p. Dep. NTIS.

Declassified 3 Nov 1971.

The intermediate temperature problems associated with certain beryllides are outlined, as well as work designed to understand and eliminate these problems. Studies concerning the effects of impurities have commenced, but no definite conclusions can be made at this time. The problems are shown to be, thus far, nonexistent for the tantalum beryllides. Compressive strength and modulus-of-rupture data as a function of temperature are presented for certain beryllides of interest. (auth)

26053 (BDX-613-414) CVD SCALING STUDY. Miller, N. E.; Stablein, P. F. Jr. (Bendix Corp., Kansas City, Mo.). [1970]. 11p. Dep. NTIS.

A scaling method for modeling one chemical vapor deposition (CVD) application after another has been derived for similar shapes. The proposed method provides information describing the interrelationship of the CVD process variables and parameters required for quantitative guidance and is applicable to a variety of shapes and materials. Two classical shapes—hemispherical and cylindrical—are treated. These shapes represent axisymmetric and three-dimensional geometries and were selected to simplify presentation of the scaling method. (auth)

26054 (BMI-1921) LOW-CYCLE FATIGUE AND CREEP FATIGUE OF INCOLOY ALLOY 800. Jaske, Carl E.; Mindlin, Harold; Perrin, James S. (Battelle Columbus Labs., Ohio). Feb 1972. Contract W-7405-eng-92. 56p. Dep. NTIS.

The low-cycle fatigue behavior of solution-annealed Incoloy Alloy 800 was studied over the temperature range of 70 to 1400°F, with primary emphasis placed upon temperatures between 1000 and 1400°F. Creep-rupture tests were conducted at 1400°F and creep-rupture data obtained from several other laboratories were analyzed to develop stress-rupture curves between 1000 and 1500°F. The heat-to-heat variation in fatigue life among four heats of material was found to be negligible for continuous cycling, and best-fit curves for total strain range versus fatigue were developed at 70, 800, 1000, 1200, and 1400°F. Using the incremental step test, cyclic stress-strain curves were developed at the same temperatures. Results showed that Alloy 800 cyclically hardened by factors between about 2 and 5, with a maximum amount of cyclic hardening at 1200°F. The effect of hold time at peak strain on low-cycle fatigue was investigated at 1000, 1200, and 1400°F. Since tensile hold times proved to be more detrimental than either compression or combined tension and compression hold times, they received primary attention. A graphical method of describing the effect of tension hold time on fatigue life was developed. Cyclically stable stress relaxation curves were analyzed and found to be approximated by a simple equation. Creep-fatigue interaction during the tensile hold-time tests was evaluated using a linear life-fraction rule. In general, damage summations close to or greater than 1.0 were obtained. (auth)

26055 (BMI-1922) PROGRESS ON LMFBR CLADDING, STRUCTURAL, AND COMPONENT MATERIALS STUDIES DURING OCTOBER THROUGH DECEMBER 1971. Keller, Donald L. (Battelle Columbus Labs., Ohio). Jan 1972. Contract W-7405-eng-92. 35p. Dep. NTIS.

Testing of Type 316 stainless steel was continued during the period reported. Twenty-five additional constant-amplitude, continuous-cycling tests were run. Curves for total strain range versus fatigue life were developed for as-received material at 70, 1050, and 1200°F and for aged material at 1050°F. A general trend of decreasing low-cycle-fatigue resistance with increasing temperature was observed. The effects of tension hold time on low-cycle-fatigue resistance of the as-received material were investigated at both 1050 and 1200°F. It was found that at both 1050 and 1200°F, the tension hold times had a detrimental influence on the cyclic fatigue life. Tensile properties of Type 316 stainless steel, Type 304 stainless steel, and Incoloy Alloy 800 were determined at 70, 800, 1000, and 1200°F. Cyclically stable stress-relaxation curves from hold-time tests of Alloy 800 were also analyzed. Information was developed on creep-fatigue damage criteria for possible inclusion in ASME Code Case 1331-5. (P.C.H.)

26056 (CNLM-3971) Cb-W-Hf STRESS RUPTURE TEST. Delgrosso, E. J.; Carlson, C. E. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 8 Feb 1962. Contract AT(30-1)-2789. 3p. Dep. NTIS.

Declassified 8 Nov 1971.

The Nb-17.7 W-7.2 Hf test alloy exhibited unusual stress rupture strength. The alloy was tested at 2400F, in a vacuum of 3×10^{-5} mm Hg at a 9,000 psi stress level. The alloy elongated 36% in 262 hours before failure was induced by intergranular surface cracking. The primary creep rate was computed to be 2.5×10^{-4} in/in per hour, and the secondary rate was 1.2×10^{-3} in/in per hour. (J.R.D.)

26057 (COO-1790-4) "IN-SITU" ELECTRON MICROSCOPE INVESTIGATION OF THE NUCLEATION AND GROWTH OF SPUTTERED THIN FILMS. Annual Technical Progress Report IV. Hutchinson, Thos. E.; Sherman, Dudley M.; Maa, Jer-shen (Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science). 27 Jan 1972. Contract AT(11-1)-1790. 67p. Dep. NTIS.

Work in the past year is reported on the sputter-deposition of metals on amorphous carbon in high vacuum (10^{-5} to 10^{-6} torr). Additional insights into the characteristics of so-called "abnormal" silver islands have been gained. Results have been obtained for the deposition of silver and niobium on single crystal substrates in high vacuum. Procedures have been devised which allow mica and graphite substrates with numerous thin areas (a few hundred angstroms thick) to be prepared onto which reproducible deposits can be formed. The dependence of the number density of observable islands in the early growth stage upon substrate temperature and deposition rate have been determined. Another area of activity in the past year has been the procurement and testing of additional vacuum equipment to ultimately allow deposition studies to be performed inside the electron microscope in improved vacuum conditions. (auth)

26058 (COO-1799-9) DIFFUSION AND PRECIPITATION OF INERT GASES IN METALS. Technical Progress Report, June 1, 1971–February 28, 1972. Cost, James R. (Purdue Univ., Lafayette, Ind. School of Materials Science and Metallurgical Engineering). 28 Feb 1972. Contract AT(11-1)-1799. 6p. Dep. NTIS.

Studies on the Al–He and Nb–He systems are reported. It was found that bubble coalescence in the Nb–He system was in agreement with that for the Al–He system, except that coalescence appeared to be even more difficult. The goal of characterizing the process of bubble nucleation in the Al–He system was found to be elusive. A new approach for studying early precipitation is described. Studies on bubble mobility and coalescence in Al–He showed that coalescence occurs more rapidly for small bubbles, and it then reaches an equilibrium size, not unlike grain growth, at which growth is very slow. Measurement of the variation of the bubble size distribution with annealing time was in best agreement with the facet nucleation-limited diffusion model. (P.C.H.)

26059 (IS-2591) EMISSIVITIES OF SELECTED LANTHANIDE METALS AT TEMPERATURES ABOVE THEIR MELTING POINTS. Stretz, Lawrence A.; Bautista, Renato G. (Ames Lab., Iowa). [1971]. 31p. (CONF-710604-6). Dep. NTIS.

From fifth symposium on temperature; Washington, D. C. (21 Jun 1971).

A method is presented for experimental determination of the spectral emissivity of liquid metals by direct comparison of the surface brightness temperature to the true sample temperature. The metal sample is held in a suitable crucible and heated with an induction furnace. The brightness temperature of the surface is determined with an automatic optical pyrometer and compared to the true sample temperature which is determined by the measurement of the brightness temperature of a blackbody cavity located within the crucible. The method was used to determine the spectral emittance of solid surfaces of yttrium, neodymium, gadolinium, and erbium and the spectral emissivities of liquid yttrium, neodymium, and gadolinium at wavelength $\lambda = 0.645\mu$. Values of the spectral emittances of the solid metals depend greatly on the surface condition of the samples but vary only slightly with changes in temperature. Spectral emissivities of the liquid metals were found to be essentially constant. Mean values of the spectral emissivities of the liquid metals are as follows: for yttrium, $\epsilon_\lambda = 0.134 \pm 0.011$; for neodymium, $\epsilon_\lambda = 0.280 \pm 0.014$; and for gadolinium, $\epsilon_\lambda = 0.342 \pm 0.009$. (auth)

26060 (IS-2683) A.C. POTENTIOMETRIC METHOD FOR HIGH TEMPERATURE RESISTIVITY AND PHASE BOUNDARY DETERMINATION. Chiotti, P. (Ames Lab., Iowa). [1971]. 19p. (CONF-710926-2). Dep. NTIS.

From Symposium on the study of crystalline transformations at high temperatures above 2000°K; Odeillo, France (27 Sep 1971).

An alternating current potentiometric method for determining the resistance of metals or alloys at high temperatures is described. The specimen in the form of a rod is mounted between water-cooled electrodes and is heated by passing an ac current through it. The potential developed between two probes about 1.0 cm apart which make contact with the middle part of the specimen is balanced against a potential across a known resistance in the secondary of a current transformer whose primary is in series with the specimen. The transformer maintains a constant ratio between the primary and secondary currents and consequently the unknown resistance between the probes on the specimen is directly proportional to the known resistance in the secondary. The balance point on the secondary resistance is independent of the primary current. Applications of the method to the study of high temperature allotropic transformations and in the determination of phase boundaries is reviewed. (auth)

26061 (LBL-176) SHORT RANGE ORDER. Das, Santosh Kumar (California Univ., Berkeley. Lawrence Berkeley Lab.). Nov 1971. Contract W-7405-eng-48. 117p. Dep. NTIS.

The nature of short range order (sro) has been investigated in the systems Au_4Cr, Au_3Cr, Ni_4Mo, Ni_3Mo, Au_3Mn, and Au_4V, by transmission electron microscopy and diffraction. The examination of the sro state, in the hot stage at temperatures above the critical temperature (T_c) for order-disorder transformation and also in the samples that were quenched from above T_c, showed diffuse scattering peaks centered near $\{1\frac{1}{2}0\}$ positions in the fcc reciprocal lattice, whose shape changed from one system to another. Evidence for diffuse scattering near superlattice positions corresponding to the Dia structure was obtained in the high-temperature diffraction patterns of Au–Cr and also in the quenched samples. The Au–V system also showed similar behavior. The diffraction patterns of Au_3Mn above T_c showed evidence for the presence of diffuse scattering near the superlattice positions corresponding to Watanabe-type two-dimensional long period superstructure. The sro diffuse scattering in Ni_3Mo and Ni_4Mo showed the presence of weak Dia and Ni_3Mo superlattice reflections, in addition to the $\{1\frac{1}{2}0\}$ peaks. The existence of the diffuse scattering near these various superlattice positions was taken as evidence for the presence of microdomains of corresponding superstructures. The diffuse scattering near $\{1\frac{1}{2}0\}$ positions was interpreted to be due to the presence of imperfectly ordered DO_{22} type microdomains. Direct evidence of these microdomains was obtained by dark field images of the corresponding superlattice reflections only after a short time aging at low temperature. Using the pairwise interaction parameters up to third nearest neighbors in the existing statistical thermodynamic model of Clapp and Moss the shapes of $\{1\frac{1}{2}0\}$ sro spots in Ni–Mo and Au–Mn alloys can be partially accounted for, but not in Au–Cr and Au–V alloys. On the other hand the diffuse sro scattering in all these alloys can be qualitatively explained by assuming the presence of imperfectly ordered microdomains of various superstructures that may exist in the long range ordered (lro) state in these alloys. For a particular stoichiometry, the structures of the microdomains that exist above T_c may or may not correspond to the equilibrium lro structure obtained at that stoichiometric composition. This description of the sro state to consist of a mixture of various types of microdomains is in accord with recent theoretical probability variational calculations of Clapp. The development of lro in Ni_3Mo is associated with decomposition into the metastable phases Ni_3Mo and Ni_4Mo, the microdomains corresponding to those that which were present in the sro state. Evidence for the presence of metastable Ni_3Mo phase was also found during ordering of Ni_4Mo. Thermodynamic justification has been given for the occurrence of these metastable phases. (auth)

26062 (N-71-35592) HIGH-TEMPERATURE, LOW-CYCLE FATIGUE BEHAVIOR OF TANTALUM. LaForce, R.; Berning, R. F.; Coffin, L. F. Jr. (General Electric Co., Cincinnati, Ohio). Sep 1971. Contract NAS3-10610. 60p. (NASA-CR-1930; GESP-595). NTIS.

Elevated-temperature uniaxial, low-cycle fatigue tests are reported for unalloyed tantalum. Because of the extreme sensitivity of this metal to environmental contamination at high temperature, special techniques were developed to provide an inert argon atmosphere during the testing. The very high ductility of tantalum at the temperatures employed (up to 1350°F), coupled with its low strength, led to geometric instabilities in the high-strain, low-cycle regime and produced special testing problems. Results were compared with those of other structural metals and are presented in terms of equivalent stress-amplitude-fatigue design life for purposes of structural design. Tantalum was found to have high resistance to low-cycle fatigue, consistent with its high ductility. (auth) (STAR)

26063 (UCLA-34-P-177-8) REACTOR STEELS STUDIES. Quarterly Progress Report. Ardell, A. J.; Ono, K.; Tetelman, A. S. (California Univ., Los Angeles. Dept. of Materials). Nov 1971. Contract AT(04-3)-34. 7p. Dep. NTIS.

Results of investigations are presented on precipitation in steels, structure and strengthening of $2\frac{1}{4}$ Cr–1 Mo steel, and fracture modes of Types 304 and 316 stainless steels. (J.R.D.)

26064 (UCLA-34-P-177-9) REACTOR STEELS STUDIES. Cr–Mo STEELS RESEARCH IN JAPAN. Ono, Kanji (California Univ., Los Angeles. Dept. of Materials). Nov 1971. Contract AT(04-3)-34. 86p. (UCLA-ENG-7177). Dep. NTIS.

Summaries of research and development activities in Japanese laboratories on Cr–Mo steels are presented. Information is included on effects of heat treatment and composition on creep-rupture properties of low-alloy steels, effects of heat treatment on rupture strength of $2\frac{1}{4}$ Cr–1 Mo steel, microstructures of precipitates in low-alloy steels, transformation of $2\frac{1}{4}$ Cr–Mo steel, properties of 9 Cr–1 Mo steel, properties of $2\frac{1}{4}$ Cr–1 Mo–Nb steel boiler tubes, and effects of Al and N on tensile properties of low-alloy steels. (J.R.D.)

26065 THERMODYNAMIC PROPERTIES OF LIQUID ALLOYS OF Ge AND In. Batalin, G. I.; Beloborodova, E. A.; Stukalo, V. A.; Sudavtsova, V. S. (Kiev State Univ.). Ukr. Khim. Zh.; 37: No. 9, 882-5(Sep 1971). (In Russian).

Thermodynamic properties of the Ge–In system at 1,020 to 1,230°K were investigated over the range of atomic fraction 0.08 to 0.87 Ge. The emf of the cell In_{liq} (InI in the melt KI + NaI) $(Ge-In)_{liq}$ was measured as a function of temperature. Free energy, enthalpy, and entropy values were calculated for the concentration range indicated. (K.S.W.)

26066 PROPERTIES OF ZIRCALOY CLADDING. Pickman, D. O. (United Kingdom Atomic Energy Authority, Preston, Eng.). pp 111-64 of Advanced Course on Limiting Aspects of Fuel Element Performance in Water Cooled Power Reactors. Kjeller, Norway; Institutt for Atomenergi (1971).

The tensile behavior of irradiated Zircaloy 2 indicates that the highest ductility will be obtained by the use of annealed material, and that the maximum resistance to plastic instability

is found with the radial basal pole texture. Cold work tends to enhance plastic instability, except in the case of a tangential basal pole texture tube. Although irradiation strengthening may not fully saturate below a fast neutron exposure 10^{22} n/cm², the major effects are seen at much lower exposures, and evidence suggests that ductility is not further reduced beyond an exposure of about 5×10^{20} n/cm². There is no suggestion that irradiation damage can lead to brittle fracture up to exposures beyond 10^{22} n/cm². The presence of zirconium hydride precipitates corresponding to up to 200 ppM H_2 does not have adverse effects on tensile properties except where the platelets are normal to the stress axis and low temperature stressing (<200°C) and unfavorable tube wall thickness/platelet length ratio is necessary to produce serious effects. Such effects are reduced if the tube has a radial basal pole texture. There is little evidence of effects of texture on secondary creep rate and in Zircaloy 2 and 4 cold work has little effect. Creep ductility is so high that creep-type failures in fuel pins are most improbable. Short term creep effects, which are important in power cycling conditions, are less affected by irradiation than secondary creep rate, but are more stress dependent and are greater when stressing is in the basal pole direction. High cycle fatigue properties are not affected by irradiation and the endurance limit is much higher than any conceivable stress resulting from fuel pin vibration. Low cycle fatigue performance is affected by the irradiation effect on ductility and reliable data are available for use in design. Life limiting effects are most likely to arise if adverse textures are produced in cladding tube, particularly in the presence of radially oriented hydrides. Irradiation damage effects will not prevent the attainment of the necessary life under BWR or PWR conditions. (Norway)

26067 URANIUM-BASE ALLOYS. Wyatt, B. S. (to Atomic Energy of Canada Ltd.). Canadian Patent 885,927. 16 Nov 1971.

A uranium-base alloy for nuclear fuel is described that contains 3.5 to 3.7 wt% Si and 01.0 to 1.5 wt% Al. On heat treatment, the structure consists mainly of a matrix of delta phase U_3Si with a minor amount of UAl_2. Improved processing properties are obtained over the binary delta U_3Si alloy, and better corrosion resistance, compared to a similar ternary alloy with less Si and a free uranium phase. (F.S.A.) (Canada)

26068 SYMMETRY TYPES IN SECOND-ORDER PHASE TRANSITIONS IN O_h^3 CRYSTALS. Shamrai, V. F. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 200: No. 5, 1160 (11 Oct 1971). (In Russian).

The physical properties of the compounds $Nb_3(X,Y)$ and $V_3(X,Y)$, described by the steric grouping O_h^3, were fixed to a considerable extent by the change in the type of crystal lattice in phase transition points of the second order. Changes in the symmetry of such compounds as $Nb_{12}Al_3Ge$ and V_3Si at temperatures ≤21°K are elucidated. (K.S.W.)

26069 PLASTIC DEFORMATION OF ORIENTED MOLYBDENUM SINGLE CRYSTALS. Savitskii, E. M.; Burkhanov, G. S.; Kuz'mishchev, V. A. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 200: No. 5, 1070-3(11 Oct 1971). (In Russian).

Samples of a Mo parallelopiped 4 × 5 × 20 mm were cut from a zone-refined monocrystal, and changes in the microstructure in cold-rolled samples were noted which corresponded to (100), (110), or (111) planes, respectively. With increase in the deformation of the crystal, crushing of the subgrain structure occurred, accompanied by an increase of angular disorientation and dislocation density. These changes were reflected in an anisotropy of microhardness in the deformed grain. (K.S.W.)

26070 SECOND ALL-UNION CONFERENCE ON THE THERMODYNAMICS OF METALLIC ALLOYS, HELD AT KIEV, SEPTEMBER 22–26, 1969. Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1077-1206(Aug 1971). (CONF-690986).

Translated from Zh. Fiz. Khim.; 45: No. 8, 1889-2123(Aug 1971).

Sixty-one articles are included; separate abstracts were prepared for 20. The remaining 41 articles contain information on the thermodynamics of alloys and systems not in scope for NSA. Abstracts of 37 papers are also included. (P.C.H.)

For abstracts of individual papers see: 25976–25980 and 26071–26085.

26071 PRESENT STATE OF RESEARCH ON THE THERMODYNAMICS OF ALLOYS OF THE RARE-EARTH METALS. Bayanov, A. P. (Metallurgical Inst., Novokuznetsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1077-83(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 1889(Aug 1971).

The variation in the enthalpy of formation of rare earth metal halides was examined in the sequence from lanthanum to lutetium. The thermodynamic characteristics were found to depend on the degree of oxidation of europium and ytterbium. Experimental data on the thermodynamics of 90 intermetallic compounds were reviewed systematically. The thermodynamic properties of the molten alloys are discussed. Alloys with p-type metals were characterised by low activity coefficients of the rare-earth metals. The possibility is discussed of using various types of electrolytic cells for different rare earth metals to determine thermodynamic characteristics by the emf method. An equation was derived for calculating activity. Possible methods are given for calculating the thermodynamic properties of rare earth metal alloys, together with the main results of the calculations. (81 references) (auth)

26072 ACTIVITIES OF COMPONENTS OF TERNARY AMALGAMS. Kozin, L. F.; Nigmetova, R. Sh.; Dairova, A. M. (Inst. of Chemical Science, Alma-Ata, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1086-9(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 1906-11(Aug 1971).

Measurement of the vapor pressure of mercury has been used to determine its thermodynamic activity in the ternary systems which it and cadmium form with tin, indium, lead, and bismuth, respectively. The values obtained for the activities of the components in these systems indicate departures from ideality of different signs. The negative deviations observed are due to the development of interatomic interaction of the components in the limiting binary systems. (auth)

26073 CORRELATION OF PHYSICAL PROPERTIES OF PURE SOLID METALS WITH THEIR RESISTANCE TO CORROSION BY LIQUID B METALS. Yatsenko, S. P. (Inst. of Chemistry, Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1095-8(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 1923-8(Aug 1971).

Solubility data for 50 metals in liquid gallium have been obtained for the first time by isothermal saturation and viscometric methods, and data on the resistance of 42 pure solid metals to isothermal corrosion by liquid gallium under static conditions. The correlation of the physical properties of the metals with their solubility in and resistance to gallium is discussed. (auth)

26074 DETERMINATION OF LIMITING HEATS OF MIXING FROM SOLUBILITY DATA IN LIQUID METALS. Yatsenko, S. P.; Anikin, Yu. A. (Inst. of Chemistry, Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1104-6(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 1942-5(Aug 1971).

Partial molar heats and entropies of dissolution have been calculated for seventeen metals from experimental data on their limiting solubility in liquid gallium. Results for the limiting heats of mixing of lead, cadmium, thallium, and bismuth with liquid gallium agreed with calorimetric measurements. Solubility data for four groups of analogous metals in two solvents did not support the constancy of Keck and Broder's factor $\Delta H_\infty/r^3$. For multivalent liquid metals the limiting heat of dissolution was greater in absolute magnitude on dissolution in the metal of lower valency. (auth)

26075 CALCULATION OF THE THERMODYNAMIC PROPERTIES OF TERNARY LIQUID METALLIC SYSTEMS FROM DATA FOR BINARY SYSTEMS. Morachevskii, A. G.; Gerasimenko, L. N. (Polytechnic Inst., Leningrad). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1109-10(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 1951-3(Aug 1971).

Various possible ways of calculating integral thermodynamic characteristics of ternary liquid metallic systems from data for binary systems have been examined. The simplest relations have been noted for ternary systems (1–2–3) for which the boundary binary systems 1–2 and 1–3 exhibit considerable negative deviations from ideality and the 2–3 system is close to ideality or is regular. The possibility of applying the Redlich–Kister method in the calculations of the thermodynamic properties of ternary metallic systems has been demonstrated. (auth)

26076 THERMODYNAMIC PROPERTIES OF THE URANIUM–ZINC SYSTEM. Volkovich, A. V.; Kanashin, Yu. P.; Lebedev, V. A.; (and others) (Polytechnic Inst. of the Urals, Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1123-5(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 1979-82(Aug 1971).

Partial molar and integral thermodynamic quantities for the formation of uranium–zinc solutions (from the liquid components) and of the compound U_2Zn_{17} (from solid uranium and liquid zinc) have been calculated. The temperature dependence of the solubility of uranium in liquid zinc in the range 610 to 825°C has been determined. (auth)

26077 THERMODYNAMICS OF THE REACTION OF ZINC WITH LANTHANUM AND CERIUM. Lebedev, V. A.; Nichkov, I. F.; Raspopin, S. P.; Mullayanov, R. Kh.; Semenov, B. G. (Urals Polytechnic Inst., Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1126-7(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 1983-5(Aug 1971).

The thermodynamic properties of liquids alloys of lanthanum and cerium with zinc have been investigated by an emf method. There are appreciable negative deviations of the activities of lanthanum and cerium in the zinc solutions from Raoult's law, increasing with decrease of temperature and on passing from cerium to lanthanum. Data on the solubilities of lanthanum and cerium in molten zinc, obtained by an emf method, are presented. (auth)

26078 STATE OF LANTHANUM, CERIUM, AND YTTRIUM IN BISMUTH SOLUTIONS. Kober, V. I.; Lebedev, V. A.; Nichkov, I. F.; Raspopin, S. P.; Belousov, A. I. (Urals Polytechnic Inst., Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1127-9(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 1986-8(Aug 1971).

The thermodynamic properties of solutions of lanthanum, cerium, and yttrium in fused bismuth have been investigated by an emf method. Appreciable negative deviations from Raoult's law of the activity of the potential determining element, increasing with decrease of temperature and on passing from yttrium to lanthanum, have been established. A correlation between the thermodynamic characteristics of the solution and the ionization potentials of the valence electrons of the dissolved element has been demonstrated. (auth)

26079 THERMODYNAMIC PROPERTIES OF BINARY LIQUID ALLOYS OF GERMANIUM WITH TIN AND INDIUM. Batalin, G. I.; Beloborodova, E. A.; Stukalo, V. A. (Kiev State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1136-7(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 2002-4(Aug 1971).

The thermodynamic properties of binary liquid alloys of germanium with tin and lead have been measured by the emf method. The thermodynamic activities of the components, the partial and integral free energies, and the entropies and enthalpies of mixing have been calculated. The confidence limits of the thermodynamic functions are also given. The systems showed small deviations from ideal solution behavior. The largest values of ΔH and ΔS^{exc} were positive, and shifted towards the component with the smaller homopolar bond contribution. The results are explained in terms of differences in the interatomic binding forces in liquid germanium on the one hand and in liquid tin and indium on the other hand. (auth)

26080 THERMODYNAMIC PROPERTIES OF CERIUM–GALLIUM ALLOYS. Vnuchkova, L. A.; Bayanov, A. P.; Serebrennikov, V. V. (Metallurgical Inst., Novokuznetsk, USSR. Tomsk State Univ., USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1140-1(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 2010-12(Aug 1971).

The thermodynamic properties of cerium–gallium alloys have been studied by the emf method at 675 to 975°K and cerium concentrations up to 10 wt %. The partial molar and the integral thermodynamic characteristics for the liquid alloys and for the compound $CeGa_2$ have been calculated, and the solubility of cerium in liquid gallium has been determined. (auth)

26081 ENTHALPY OF FORMATION OF SOLID AND LIQUID INDIUM–ANTIMONY AND GALLIUM–ANTIMONY SOLUTIONS. Mechkovskii, L. A.; Savitskii, A. A.; Skums, V. F.; Vecher, A. A. (State Univ., Minsk). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1143-4(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 2016-17(Aug 1971).

The enthalpies of formation of solid and liquid InSb–GaSb solutions and the heats of melting of the compounds InSb and GaSb have been determined by quantitative differential thermal analysis. The enthalpies of formation were negative, showing that stable solutions are formed in the InSb–GaSb system. (auth)

26082 VAPOUR PRESSURE OF LIQUID PALLADIUM ALLOYS. Vatolin, N. A.; Timofeev, A. I.; Dubinin, E. L. (Inst. of Metallurgy, Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1149-50(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 2027-9(Aug 1971).

The vapor pressure of the components over the melts has been measured by the Knudsen effusion method for six binary systems involving palladium and Ag, Cu, Co, Ni, Fe, or W. The thermodynamic activities of the components have been calculated. (auth)

26083 THERMODYNAMIC PROPERTIES OF ALUMINUM–TITANIUM AND ALUMINUM–VANADIUM ALLOYS. Samokhval, V. V.; Poleshchuk, P. A.; Vecher, A. A. (State Univ., Minsk). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1174-6(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 2071-3(Aug 1971).

The Gibbs free energies, enthalpies, and entropies of formation of aluminum–titanium alloys at 960°K and aluminum–vanadium alloys at 980°K have been determined with the aid of a cell with a solid electrolyte. (auth)

26084 ACTIVITIES IN THE URANIUM–BERYLLIUM SYSTEM. Pyatkov, V. I.; Lebedev, V. A.; Nichkov, I. F.; (and others) (Urals Polytechnic Inst., Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1184-6(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 2088-91(Aug 1971).

The results of kinetic and equilibrium measurements, whereby it is possible to establish fairly reliably the thermodynamic characteristics of uranium–beryllium alloys, are presented. (auth)

26085 THERMODYNAMICS OF THE INTERACTION BETWEEN BERYLLIUM AND ALUMINUM. Serebryakov, G. A.; Lebedev, V. A.; Nichkov, I. F.; Raspopin, S. P.; Novikov, E. A. (Urals Polytechnic Inst., Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 8, 1186-9(Aug 1971).

From Conference on the thermodynamics of metallic alloys; Kiev, USSR (22 Sep 1969).

Translated from Zh. Fiz. Khim.; 45: No. 8, 2092-4(Aug 1971).

The activity of beryllium in liquid aluminum solutions has been measured by an emf method in the range 680 to 800°C. Positive deviations of the activity from Raoult's law have been found. The dissolution of beryllium in aluminum was accompanied by absorption of heat and an increase of excess entropy. The equality of the free energies of solutions saturated with beryllium and of metallic beryllium was evidence that no compounds are formed in the system. Data are presented for the solubilities of beryllium in aluminum obtained by an emf method. (auth)

26086 SURFACE SEGREGATION STUDIES IN ALLOYS USING AUGER ELECTRON SPECTROSCOPY. Dooley III, George J. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). J. Vac. Sci. Technol.; 9: No. 1, 145-9(Jan–Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

Several metals used in the nuclear field are found to be lacking in one or more respects when these metals are employed in their pure or unalloyed state. For a variety of reasons, minor alloying additions are often added to these pure metals. However, the basic role played by these alloying elements is not well understood. By utilizing the technique of Auger electron spectroscopy on Zircaloy-2 and Zircaloy-4, it has been possible to make correlations between observed surface phenomena (of both impurity and alloy species) and previously established mechanical properties, such as a strain rate sensitivity around 300°C in the Zircaloys, and also chemical properties such as the buildup of an oxide layer above 300°C in these same zirconium alloys. (auth)

26087 STUDY OF THE COMPETITIVE DIFFUSION AT 525°C OF NITROGEN AND OXYGEN IN SPUTTERED β-TANTALUM FILMS. Croset, M.; Velasco, G. (Thomson CSF, Orsay, France). J. Vac. Sci. Technol.; 9: No. 1, 165-8(Jan–Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

Thin β-tantalum films, from 200 Å to 1 μ thick, deposited on silicon by diode sputtering in argon at 10^{-2} torr, were treated at 525°C in nitrogen containing well-defined quantities of oxygen and water traces in the parts per million range. The composition of

the films, the nitrogen and oxygen incorporation kinetics, were studied by the observation of the nuclear reactions $^{16}O(d,p)^{17}O^*$ and $^{14}N(d,\alpha)^{12}C$ and by ion-microprobe mass spectrometry. These experiments established the following points: the predominant initial step of the process corresponds to a rapid (some minutes) nitrogen filling of the film with an almost uniform depth distribution up to an N/Ta ratio of 0.16; in a competitive process, a simultaneous incorporation of oxygen takes place and imposes the out-diffusion of the nitrogen, and surface-oxide film interference colors appear only after the nitrogen removal. (auth)

26088 STRESS ORIENTATION OF HYDRIDE PLATELETS IN ZIRCONIUM ALLOY TUBING AND ITS EFFECT ON MECHANICAL PROPERTIES. Hindle, E. D.; Slattery, G. F. (United Kingdom Atomic Energy Authority, Springfields, Eng.). pp 1-14 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

The effects of tube fabrication procedures and changes in composition on the susceptibility of zirconium alloy tubing to form radially aligned hydride platelet chains under stress were studied. In addition, the effects of stress oriented hydride on the mechanical properties of the tubing were assessed using biaxial rupture and ring tensile tests. A metallographic parameter H_L was introduced which expresses the maximum percentage of the wall thickness occupied by radially aligned hydride platelet chains and includes not only the angular orientation of the platelet but also length. Short radial chains of platelets have a less deleterious effect on tube rupture ductility than long chains. For similar cooling rates, the platelets observed in Zr/Cr/Fe tubing were shorter than those in Zircaloy-2 tubing, and this was reflected in improved rupture ductility. The relative susceptibilities of Zircaloy-2 and Zr/Cr/Fe tubing to the formation of radial hydride during precipitation under a hoop stress of 30,000 lb/in^2 (207 MN/m^2) were correlated with the basal pole intensities in the radial direction. Tubing with a high basal pole concentration radially tends to be more resistant to the formation of radial hydride under stress. (auth)

26089 CARBURISATION OF STAINLESS STEELS IN SODIUM CONTAINING CARBON IMPURITIES AND ITS EFFECT ON MECHANICAL PROPERTIES. Thorley, A.; Tyzack, C. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 143-54 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

Some of the factors involved in determining how much carbon might be taken up by a stainless steel exposed to high temperature sodium containing small amounts of carburising impurities are examined, and some data are presented on the kinetics of carburisation of stainless steels from various carbon bearing impurities in sodium, and the effects of various levels of carbon on the tensile properties of materials of interest. (auth)

26090 PRELIMINARY STUDY OF THE EFFECT OF HELIUM ENVIRONMENT ON THE CREEP AND RUPTURE BEHAVIOUR OF TYPE 316 STAINLESS STEEL AND INCOLOY 800. Wood, D. S.; Farrow, M.; Burke, W. T. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 213-28 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London; Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

Creep and stress rupture tests of up to about 5000 h duration were carried out on Type 316 stainless steel at 800°C and Incoloy 800 at 650°C. Tests were performed in air and in helium containing two different levels of impurities. The results indicated that tests in helium give shorter rupture lives and higher creep rates than tests in air at similar temperature and stress levels. Metallographic examinations carried out on failed specimens indicated a pronounced difference in surface oxidation between the specimens tested in air and those tested in helium. It is suggested that this difference in oxidation behavior may be responsible for the reduced creep and rupture strength observed in the helium environments. (auth)

26091 LOW TEMPERATURE SPECIFIC HEAT OF ThU. Luengo, C. A. (Univ. Nacional, Cuyo, Argentina); Cotignola, J. M.; Sereni, J. G.; (and others). Solid State Commun.; 10: No. 5, 459-63(1 Mar 1972).

The low-temperature specific heat of the weakly magnetic system ThU was measured in both the normal and superconducting states. U impurities were found to enhance the normal state electronic specific heat coefficient γ at an unusually large rate of 4.85 ± 0.50 mJ/mole °K^2 at. % U. The specific heat jump at the superconducting transition for an alloy of composition 0.075 at. % U follows the BCS law of corresponding states suggesting that the system ThU is essentially non-magnetic at superconducting temperatures. (auth)

26092 INFLUENCE OF HEAT TREATMENT ON THE MECHANICAL, ELECTROCHEMICAL, AND CORROSION CHARACTERISTICS OF ZINC AND SOME ZINC ALLOYS. Bulgacheva, N. M.; Layner, D. I. Tr., Gos. Nauch.-Issled. Proekt. Inst. Splavov Obrab. Tsvet. Metal.; No. 31, 3-8(1970). (In Russian).

The effects of annealing without a protective atmosphere at 100 and 200° on the characteristics of zinc and Zn–In (0.1%), Zn–Ce (0.07%), Zn–Pb (0.3%), and Zn–Fe (0.1%) alloys were studied. It was found that annealing worsened all the properties of Zn, due to the growth of grains, segregation of additions along boundaries, and non-uniform growth of a surface oxide film. (Corros. Control Abstr.)

26093 SOME FEATURES OF ALLOYS OF ZINC WITH INDIUM, LEAD, AND MERCURY, OBTAINED BY TREATMENT OF ZINC FOIL IN AMALGAMATION SOLUTIONS CONTAINING INDIUM AND LEAD. Layner, D. I.; Bulgacheva, N. M.; Dorokhina, L. N.; Neyman, E. Ya. Tr., Gos. Nauch.-Issled. Proekt. Inst. Splavov Obrab. Tsvet. Metal.; No. 31, 9-19(1970). (In Russian).

The composition, structure, and electrochemical, corrosion, and mechanical properties of Zn alloys with In and Pb were compared, the alloys being obtained by a casting method and by contact introduction of In and Pb into Zn foil in amalgamation solutions. An improvement in corrosion properties was observed in alloys obtained by a contact method, but the alloying elements were less uniformly distributed, being mainly concentrated in the surface layers, which can have an unfavorable influence on electrochemical properties at high In and Pb concentrations. (Corros. Control Abstr.)

26094 STUDY OF THE PHASE TRANSFORMATIONS IN U–V ALLOYS. EFFECTS OF CARBON CONTENT. Collot, C. (Centre d'Etudes, Bruyeres-le-Chatel, France); Couterne, A.; Guillaume, C.; Giraud-Heraud, F.; Guillaumin, J. J. Nucl. Mater.; 43: No. 1, 28-50(Apr 1972). (In French).

Studies were completed on the refinement of the U–V alloys with a low V content (from 0.1 to 1%). The kinetics of the $U_\beta \rightarrow U_\alpha$ transformation which determines the size of the α grains were in particular most sensitive to the carbon content. Microdiffraction analysis of the precipitates formed upon cooling these alloys gave evidence of a V–C type of interaction in the solid phase, the characteristics of which are given. The transformation curves, which were obtained for different V and C contents, showed that the latter element cannot only deflate the β matrix in V through the formation of carbides of composition V_2C or with an intermediate formula between V_2C and VC but can also act on the intrinsic stability of the $(U,V)_\beta$ solution. The refinement of the α grain in the U–V alloys was controlled by a set of parameters whose influence can be more or less important. These were in particular: The V content—the C content, which however, in the form of carbide particles, would not take part in the heterogeneous germination of the α phase—the solidification rate, which mainly determines the size of the γ grain, than that of the β grain, i.e., the kinetics of the $U_\beta \rightarrow U_\alpha$ reaction. (auth)

26095 ENTHALPY OF SOLID AND LIQUID MOLYBDENUM BY LEVITATION CALORIMETRY. HEAT OF FUSION OF MOLYBDENUM. Berezin, B. Ya.; Chekhovskoi, V. Ya.; Sheindlin, A. E. (Inst. for High Temperatures, Moscow). High Temp. - High Pressures; 3: No. 3, 287-97(1971).

The enthalpy of solid molybdenum was determined in the temperature range 1962 to 2869°K by drop calorimetry using induction heating of the specimen in an electromagnetic "crucible" and a copper block calorimeter. An empirical equation was fitted to the experimental data by the least squares method. The enthalpy of liquid molybdenum was measured in the temperature range 2890 to 2925°K. The enthalpy data for solid and liquid molybdenum yielded 8741 ± 314 cal g-at^{-1} as its heat of fusion. The accuracy of the results was analyzed. (auth)

26096 CALCULATION OF THE HYDROGEN DIFFUSION IN THE ZIRCALOY–YTTRIUM LAYERS WITH A GENERALIZED EIGENFUNCTION METHOD. Mertins, H.; Lahann, H.-J. Atomkernenergie; 19: No. 2, 92-6(Apr 1972). (In German).

The diffusion of hydrogen in a combination of two metals with different affinity to hydrogen was investigated at constant temperature. Because of the concentration jump at the boundary between the two metals due to the distribution law of Nernst the

method of expanding the solution into eigenfunctions of the problem must be generalized towards piecewise continuous eigenfunctions. The solution shows how the hydrogen take-up by yttrium depends on the diffusion constants, the distribution coefficient, and the slab-diameters. A method to determine the diffusion constants and the distribution coefficient from the experimental curves is presented. (auth)

26097 DISTRIBUTION OF BISMUTH TRACES IN THE GRAIN BOUNDARY REGION OF TECHNICAL COPPER. Grosel, J.; Radwan, M. (Institut fuer Kernforschung, Swierk, Poland). Isotopenpraxis; 7: No. 11-12, 449-51(Nov-Dec 1971). (In German).

To determine bismuth distribution in copper, autoradiography did not yield sufficient resolution. Therefore, a method was developed that uses the etching of intercrystal breaks. ^{210}Bi was produced in a reactor by neutron activation. The isotope was then added to copper. From the alloy, wires were formed that were cooled in liquid nitrogen and broken. The samples were then etched in 0.1 normal $FeCl_3$ and 0.8 normal HCl. Bismuth content corresponded to the radioactivity of the etching solution. Following neutron activation of the broken samples, copper content was obtained in the same manner. Copper samples with bismuth contents of 40 to 100 ppM showed a large accumulation of the trace element in the boundary region of grains when the samples were heated to 580°C for half an hour. The degree of accumulation did not decrease proportionally with decreasing bismuth content. Heating to 750°C led to a better distribution of bismuth. (H.B.G.)

26098 OBSERVATION ON THE KINETIC BEHAVIOR OF A PARABOLIC TYPE METAL–GAS REACTION WITH INDUCED CRACKS IN THE SCALE: A NOTE. Zirin, Moshe H. (Ford Motor Co., Dearborn, Mich.). Oxidation Metals; 3: No. 6, 539-44(Nov 1971).

A model, which is proposed for the kinetic behavior of a parabolic type metal–gas reaction with induced cracks in the scale, was supported by experimental evidence. Cd wire was fluorinated at 300°C, and the reaction rate showed a perfect parabolic behavior. The reaction temperature was then raised. Initial plots at the new temperature showed deviations from the expected pattern. The reaction was then terminated, the sample removed, mounted, and polished. A crack of large dimensions and its effect on the kinetic observations (product generated at the bottom of the crack) were clearly evident. (P.C.H.)

26099 TWINNING AND TEXTURE TRANSITIONS IN TITANIUM SOLID-SOLUTION ALLOYS. Larson, Frank Robert. Providence; Brown Univ. (1971). 160p. University Microfilms Order No. 72-8145.

Thesis.

The preferred orientation of cold-rolled sheet processed from laboratory heats of several titanium binary alloy series was studied. Titanium-based alloys of iron, manganese, chromium, cobalt, nickel, copper, molybdenum, vanadium, niobium, aluminum, tin, and zirconium were studied. It was found that additions of beta stabilizers caused a texture transition when the retained beta was in excess of about 16 volume percent. This texture transition, for the basal pole, may be roughly described as an unalloyed titanium to zinc type transition. Copper was an exception and alloys of this element had a tendency to form an "ideal" $\{0001\}\langle 10\bar{1}0\rangle$ type texture similar to that previously found for additions of the alpha stabilizer aluminum. Neutral alloying elements like tin and zirconium were found to have only a small effect upon the texture, merely sharpening the unalloyed type. Little effect of lattice parameters was noticed except for a trend of high c/a ratio alloys to produce a component of a stable end orientation of the $\{11\bar{2}0\}\langle 10\bar{1}0\rangle$ type. A qualitative discussion of how these textures form is included; however, due to a lack of complete information about roll-gap stresses and deformation, along with absence of values for critical stresses for slip and twinning in these alloys, it was not possible to be quantitative. (Diss. Abstr. Int., B)

26100 FIELD-ION MICROSCOPE STUDY OF EARLY STAGES OF ORDERING IN Ni_4Mo ALLOY. Yamamoto, Masahiko; Nenno, Soji; Futamoto, Masaaki; Nakamura, Shogo (Osaka Univ.). Jap. J. Appl. Phys.; 11: No. 4, 437-44(Apr 1972).

Field-ion microscope observations are made on the Ni_4Mo alloy to investigate the ordering process during isothermal annealing at 800°C after quenching from high temperature α-region. Field-ion images of the Ni_4Mo alloy in the early stages of annealing at 800°C indicate that long-range ordered domains are distributed sparsely in the short-range ordered matrix. Thus, it is concluded that the ordering at 800°C takes place by nucleation and growth of long-range ordered domains in the short-range ordered matrix. It has been found that the ordering process of the alloy is sensitive to heat treatment, namely heating rate to the annealing temperature, 800°C, from room temperature. Some features such as dark regions observed in field-ion images of the Ni_4Mo alloy are briefly discussed. (auth)

26101 CONTINUOUS COOLING TRANSFORMATION OF BINARY $\alpha + \beta$ AND METASTABLE β TITANIUM ALLOYS. Ikawa, Hiroshi; Shin, Shigeo; Morikawa, Masaki (Osaka Univ.) Technol. Rep. Osaka Univ.; 21: 475-99(Oct 1971).

The investigation was carried out for making continuous cooling transformation (CCT) diagrams of Ti–Cr, Ti–Mn, Ti–V and Ti–Mo alloys and especially for the precipitation area of ω phase on the cooling process in binary $\alpha + \beta$ titanium alloys and binary metastable β titanium alloys. In these alloys the supersaturated β phase decomposes on the cooling process from β phase region by the following three ways, depending on solute concentration and cooling rates; $\beta_0 \rightarrow B_i + \alpha' + \omega(\omega')$, $\beta_0 \rightarrow \beta_i + \omega(\omega')$, and $\beta_0 \rightarrow \beta_i + \alpha$. The ω' phase is a pre-state of ω phase which is not observed by thermal analysis although it can be observed by transmission electron microscopy. The precipitation temperature of ω phase in the cooling process decreases with the increase of cooling rates. The precipitation area of ω phase in Ti–Cr, Ti–Mn, Ti–V, and Ti–Mo alloys can be shown as one area when arranged by cooling process and by electron concentration. Excluding that area, it is possible to prevent from precipitation of ω phase in the welded zones of binary $\alpha + \beta$ titanium alloys and binary metastable β titanium alloys. (auth)

26102 METALLURGIYA I METALLOVEDENIE CHISTYKH METALLOV. VYPUSK IX. (Metallurgy and Metallography of Pure Metals. Number IX). Krainov, E. P. (ed.). Moscow; Atomizdat (1971). 176p.

This collection of 24 papers by various authors discusses original investigations of the structure and physico-mechanical properties of refractory, rare, and radioactive metals: Mo, W, Zr, V, U, and their alloys and compounds. Refining problems and associated transport reaction theory are considered. Fine structure, monocrystalline and polycrystalline states, corrosion behavior, sublimation and diffusion characteristics, and internal friction of some of these elements, alloys, and compounds comprise the subject matter of many of the papers. (tr-auth)

26103 PHASE TRANSFORMATIONS. Conference Held at Detroit, Michigan, October 12–13, 1968. Metals Park, Ohio; American Society for Metals (1970). 646p. (CONF-681090).

The topics discussed in the 13 chapters included are: crystal geometry and mechanisms of phase transformations in crystalline solids; surface relief effects in solid-state phase transformations; nucleation of martensite; growth of a plate of martensite; calculation of phase equilibria; nucleation in solids; nucleation at imperfections; mechanisms of diffusional growth of precipitate crystals; bainite transformation; massive transformations; cellular and pearlitic reactions; spinodal decomposition; and order–disorder transformations. (P.C.H.)

26104 TEMPERATURE DEPENDENCE OF YOUNG'S MODULUS OF NIOBIUM–TITANIUM ALLOYS. Albert, Helmut; Pfeiffer, Irmtraud (Vacuumschmelze GmbH, Hanau, Ger.). Z. Metallk.; 63: No. 3, 126-31(Mar 1972). (In German).

In analogy to the behavior observed on niobium–zirconium alloys NbTi 65 exhibited an anomalous increase of Young's modulus subsequent to heavy cold work, which was due to an interaction of foreign atoms with dislocations. For NbTi 50 and NbTi 40 Young's modulus was nearly independent of temperature. This may be explained with nearly temperature independent interactions between stacking faults and foreign atoms enriched on stacking faults. Annealing treatments at 350°C lowered the positive temperature coefficient of Young's modulus of NbTi 65 because of the precipitation of α-titanium. The values of the temperature coefficient for NbTi 50 and NbTi 40, however, remained practically constant, as there was no precipitation in these alloys. An anomaly of the temperature dependence of Young's modules subsequent to recrystallization, which was due to a [111] or a [110] recrystallization texture, was found in the case of the Nb–Ti alloys as for Nb–Zr alloys. The fraction of [111] orientations decreased with decreasing titanium content in favor of a [100] texture, so that NbTi 40 showed a lower anomalous effect than did NbTi 50 and NbTi 65. By precipitating the ω-phase in NbTi 65 the anomaly was made to disappear. (auth)

26105 SOLUBILITY OF CARBON IN NIOBIUM AT HIGH TEMPERATURES. Hoerz, Gerhard; Lindenmaier, Klaus (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk.; 63: No. 3, 145-8(Mar 1972). (In German).

The solubility limit of carbon in niobium has been determined at temperatures between 1500 and 2150°C. The saturation concentrations were obtained from curves describing the electrical conductivity of niobium at the temperature of carburization in dependence on the reaction time and from the known relation between electrical conductivity and carbon concentration. The saturation

concentration c_S of carbon in the α niobium–carbon solid solution increased from 0.26 at. % C at 1500°C to 4.0 at. % C at 2200°C according to the relation $c_S = 4.2 \times 10^3 \exp(-34.2 \times 10^3/R\ T)$ (R gas constant, T absolute temperature in °K). The hexagonal β-carbide Nb_2C was in equilibrium with the α phase at all temperatures of the study. (auth)

26106 BULK MODULUS OF PURE METALS AND ITS PRESSURE DEPENDENCE AS CALCULATED FROM SHOCK WAVE DATA. Schramm, Karl-Heinz (Battelle Institut eV, Frankfurt am Main). Z. Metallk.; 63: No. 3, 148-51(Mar 1972). (In German).

For a strong shock wave, as may be produced, e.g., by means of high explosives, which runs through a metallic body, the empirical relation $v = C + S \cdot u$ between its velocity of propagation, v, and the flow rate of the material, u, is known to exist. The characteristic constants of the material, C and S, can be determined quite precisely from experiment. The bulk modulus and its pressure dependence were calculated for several metals from their initial density ρ_0 and the data for C and S. (auth)

26107 ELIMINATION OF DEFECTS PRODUCED IN A VAN ARKEL TYPE Zr BY WORK HARDENING AT 78 DEG K. Vialaret, Pierre; Dimitrov, Colette (CNRS, Vitry-sur-Seine, France). Compt. Rend., Ser. C; 274: No. 2, 136-9(10 Jan 1972). (In French).

The recovery of the electrical resistivity of Zr, which had been heavily deformed by rolling at 78°K, was observed to occur in 3 stages prior to the recrystallization. The first two stages occurring at about 118°K(A) and 236°K(B) are attributed to the elimination of point defects. Stage A has an associated activation energy constant of 0.37 ± 0.06 eV; the structure of stage B is complex. The third stage (C) corresponds to a decrease in the resistivity, which can be attributed to dislocation phenomena. (France)

26108 ESTIMATION OF THE Nb–W PHASE DIAGRAM. Allibert, Colette; Driole, Jean (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, Grenoble, France). Compt. Rend., Ser. C; 274: No. 5, 490-3(31 Jan 1972). (In French).

The application of the Guggenheim model to the study of the thermodynamic properties of ternary Ni–Nb–W solutions and the use of the phase diagrams of the Ni–Nb, Ni–W and Ni–Nb–W systems allow the Nb–W phase diagram to be estimated. (France)

26109 HYDROGEN ADSORPTION–ABSORPTION BY NIOBIUM. Johnson, LeRoy. Pullman, Wash.; Washington State Univ. (1971). 72p. University Microfilms Order No. 72-7653.

Thesis.

Sorption by hydrogen by a polycrystalline niobium wire was studied under clean conditions via ultra-high vacuum techniques. The adsorption of small amounts of hydrogen on a clean niobium surface was investigated as well as absorption into the bulk of much larger amounts of hydrogen. Evidence for a precursor surface adsorption state and subsequent diffusion into the bulk was found. A clean surface sticking coefficient of 0.13 was measured. Isotherms of the concentration of dissolved hydrogen versus the square root of the equilibrium pressure were found to be linear for concentrations below one atomic percent, in agreement with Sievert's law. Above one atomic percent anomalous behavior was observed. The electrical resistance versus concentration of dissolved hydrogen was found to be time and temperature dependent. The observations are consistent with a hydrogen clustering model. (Diss. Abstr. Int., B)

26110 MECHANICAL PROPERTIES OF HAFNIUM SINGLE CRYSTALS. Das, Gopal. Cleveland; Case Western Reserve Univ. (1971). 166p. University Microfilms Order No. 72-6281.

Thesis.

A study has been made of the deformation of hafnium single crystals (containing <2% zirconium) in the temperature range from 77 to 473°K. Slip occurred entirely on prismatic planes at all test temperatures. A three-stage hardening behavior was observed for the first time in hafnium single crystals at 77°K. The critical resolved shear stress in tension and compression was almost identical for outgassed and as-grown crystals. The yield stress was found to increase with decreasing temperature and was high for crystals containing a higher concentration of impurity compared to crystals with low impurity contents. An increase in yield stress resulted from doping crystals with nitrogen. The "Cottrell–Stokes law" for reversible flow stress was not obeyed by hafnium single crystals. The thermal activation analysis suggests that the rate-controlling mechanism during deformation at low strains is associated with the overcoming of strain-fields around impurity atoms. However, a contribution might come from the dislocation intersection mechanism at high strains. Dislocation configuration was examined by transmission electron microscopy study of foils of crystals deformed by various amounts. In stage I the dislocations are predominately edge in character. Edge dipoles and dislocations loops are present. Stage II is characterized by cell formation and increased dislocation density. (Diss. Abstr. Int., B)

26111 MATRIX BEHAVIOR IN COPPER–TUNGSTEN COMPOSITES AT SMALL STRAINS. Chawla, Krishan Kumar. Urbana, Ill.; Univ. of Illinois (1971). 98p. University Microfilms Order No. 72-6888.

Thesis.

The matrix deformation behavior and its dislocation structure were examined in the composites consisting of a single-crystal copper matrix with a small number of tungsten wires embedded in it. Dislocation etch-pit observations on the matrix showed a zone of very high dislocation density ($>10^8$ cm^{-2}) near the fibers which leveled off with distance from the interface. The dislocation density in regions far away from the fiber increased with the fiber volume fraction. The initial matrix structure was discussed on the basis of the stresses induced in the soft matrix due to the differential shrinkage between the fiber and the matrix during fabrication. The matrix stress-strain curves as derived from the composite curves on the assumption of elastic fibers showed higher micro-yield stresses and higher strain-hardening rates than the unreinforced copper crystals. This was explained in terms of the dislocation density and distribution in the deformed state. The preexisting cell walls thickened on deformation and an estimate of the dislocation mean free path indicated that it was of the order of the cell diameter. The high strain-hardening rates were thought to be due to these cell wall obstacles and not due to the fiber-matrix interaction during straining. The inelastic recovered strain obtained on unloading was found to increase after a little strain rather rapidly with strain for composites. This was explained in terms of strong restoring force from the cell wall obstacles. Thus, the fiber-matrix interaction during the fabrication and the consequent structure of the matrix were the dominant factors in determining the matrix behavior in the composite. (Diss. Abstr. Int., B)

26112 CAPILLARY-RESERVOIR DIFFUSION STUDIES IN Hg–In ALLOYS UTILIZING CONTINUOUS RESISTIVITY MEASUREMENT OF COMPOSITION. Kaiser, Robert Hamilton. Ames, Iowa; Iowa State Univ. (1971). 97p. University Microfilms Order No. 72-5216.

Thesis.

A capillary-reservoir diffusion cell has been designed to follow the process of liquid metal diffusion in the capillary on a continuous basis. Molybdenum electrodes were located at intervals along the capillary so that the composition could be monitored by noting the change in resistivity of the capillary contents. These probes were in the form of annuli with respect to the capillary which enabled the measurement of resistances without obstructing the diffusion process. This cell was used to measure the composition dependence on the diffusion coefficient in the mercury-indium system at 25°C. Compositions up to 13.19 atomic percent indium were investigated. The summary equations relating composition in atomic fraction indium and diffusivity in cm^2/sec for two capillary sections are as follows: Section 2 $D = 3.00 \times 10^{-5}\ \overline{N} + 1.48 \times 10^{-5}$ and Section 3 $D = 2.80 \times 10^{-5}\ \overline{N} + 1.30 \times 10^{-5}$. When compared with previous data on indium amalgams, the results indicate that the technique is adequate. (Diss. Abstr. Int., B)

26113 ENERGETICS, MORPHOLOGY, CRYSTALLOGRAPHY, AND THEORY OF DISPLACIVE TRANSFORMATIONS IN NEAR-EQUIATOMIC NIOBIUM–RUTHENIUM ALLOYS. Das, Bijoy Kishore. Urbana, Ill.; Univ. of Illinois (1971). 172p. University Microfilms Order No. 72-6907.

Thesis.

The displacive phase transformations in the near-equiatomic Nb–Ru alloys have been studied with magnetic susceptibility and electrical resistivity measurements, optical metallography and x-ray diffraction. Alloys containing between 41 and 45 at.% Ru undergo a CsCl (β) to face centered tetragonal (β') transformation on cooling to room temperature. Alloys containing more than 46 at.% Ru exhibit a two step CsCl (β) to face centered tetragonal (β') to face centered orthorhombic (β'') transformation on cooling to room temperature. Although the product of each successive transformation consists of stacks of twins (in $\beta' \rightarrow \beta''$, twins within twins), the transformation(s) does not proceed by advance of a sharp planar interface as in many of the first order martensitic transformations resulting in morphologically similar products. Rather, the interphase region consists of a small volume of the crystal over which the parent phase is gradually distorted into the product phase. The associated strain energy is then reduced and the transformation shows no temperature hysteresis nor any thermal history de-

pendence and thus the volume fraction transformed is a single valued function of temperature. The transformation distortions during both $\beta \rightarrow \beta'$ and $\beta' \rightarrow \beta''$ transformations are such that the arrangement of atoms in the $(101)_\beta$ plane approaches that of the hexagonal close packed structure. From the band structure changes associated with such increase in the density of packing of atoms, it could have been stated that such a sequence of structural changes as actually observed is energetically favorable. The model of the transformation thus developed accounts for the variation of transformation temperatures and transformation distortions with Ru content as well as the variation of magnetic susceptibility with temperature and Ru content. (Diss. Abstr. Int., B)

26114 ELECTRON MICROSCOPY STUDY OF CARBIDE PRECIPITATION IN VANADIUM. Diercks, Dwight Richard. Urbana, Ill.; Univ. of Illinois (1971). 124p. University Microfilms Order No. 72-6913.

Thesis.

The precipitation of carbon from supersaturated solid solution in vanadium has been investigated using transmission electron microscopy techniques on thin foils. High purity vanadium strip was doped to a carbon content of about 0.2 atomic percent and rapidly quenched in high vacuum, followed by aging treatments for various times in the temperature range of from 300 to 600°C. The strip was then thinned for transmission electron microscopy. The carbon is observed to precipitate initially as very finely dispersed carbides visible through structure factor contrast. With increasing aging the precipitate distribution coarsens, and the carbides appear as very thin coherent discs on {310} planes, showing a pronounced displacement fringe contrast. The coherent precipitate appears to have a bcc structure closely related to that of the matrix, and the composition is probably near V_2C. With further aging these discs are observed to thicken and finally lose coherency, punching out prismatic dislocation loops and helices having axes in ⟨111⟩ directions. This incoherent precipitate is found to be the hexagonal V_2C phase described by other researchers, and its orientation relationship with the matrix may be expressed $(110)_V \| (00.1)_{V_2C}$, $[\bar{1}\bar{1}1]_V \| [\bar{1}\bar{1}0]_{V_2C}$. The dislocation loops are a result of the specific volume difference between the V_2C precipitate and the matrix, and have Burgers vector b = a/2⟨111⟩. (Diss. Abstr. Int., B)

26115 MECHANICAL BEHAVIOR OF UNIAXIALLY LOADED MULTILAYERED CYLINDRICAL COMPOSITES. Hamilton, C. H. (North American Rockwell Corp., Los Angeles); Hecker, S. S.; Ebert, L. J. J. Basic Eng.; 93: No. 4, 661-70(Dec 1971).

An analytical model was developed to predict the mechanical response to axial loading of oriented fiber composite materials containing a third (dissimilar) material at the fiber-matrix interface. The model approximated the fiber composite geometry by three concentric, but integral cylinders. Both a totally elastic and an elastic-plastic analysis of the three-component cylinder demonstrated that transverse stresses, with the signs and magnitudes depending upon the elastic and plastic characteristics of the components, developed during axial loading. Tensile transverse stresses, which could drastically reduce the axial properties of the composite if a brittle layer existed at the interface, were shown to result from various combinations of component properties. The internal stresses predicted for the composite model were verified experimentally by testing three-component composite cylinders of maraging steel–copper-maraging steel and Berylco-copper-Berylco in tension. (auth)

26116 TEMPERATURE DEPENDENCE OF THE MICROHARDNESS OF SOME HIGH MELTING LAVES PHASES. Wetzig, K.; Wittig, H. (Technische Univ., Dresden). Phys. Status Solidi (a); 9: No. 1, K1-3(16 Jan 1972).

The temperature dependence of the microhardness of some high melting Laves phases ($NbFe_2$, $TaFe_2$, $NbCo_2$, and $TaCo_2$) was investigated up to 1600°K in an emission microscope. The connection between microhardness and temperature of the investigated high melting Laves phases is illustrated. The critical temperatures T_0 generally grew with increasing values of the microhardness H_M. With the exception of $NbFe_2$ the same connection existed between the melting temperature and the microhardness. (P.C.H.)

26117 STRUCTURE OF COLD-ROLLED ZIRCALOY-2 AS REVEALED BY X-RAY DIFFRACTION AND ELECTRON MICROSCOPY. Kumar, Lalit; Krishnan, R. (Bhabha Atomic Research Centre, Trombay, India). Trans. Jap. Inst. Metals; 13: No. 1, 28-31(Jan 1972).

The microstructure of cold-rolled Zircaloy-2 sheet was studied by x-ray diffraction line-broadening and transmission electron microscopic techniques. The largest percentage of changes in particle size, microstrains, and hardness were found to occur in the first 10% deformation. The dislocation densities estimated from the particle size and micro-strain measurements were comparable. Transmission electron microscopic observations of heavily cold-rolled sheet revealed dislocation cell structure containing numerous dislocations within the cells. The deformation was inhomogeneous in the material. (auth)

26118 EFFECTS OF GRAIN SIZE AND CARBON CONTENT ON THE DUCTILITY OF RECRYSTALLIZED MOLYBDENUM WIRE. Aritomi, Noriyoshi; Tsuya, Kazuo (National Research Inst. for Metals, Tokyo). Trans. Jap. Inst. Metals; 13: No. 1, 32-8(Jan 1972).

To clarify the effects of grain size and carbon content on the ductility of molybdenum, the variations in ductility with grain size were investigated on the three grades of 1 mm wire specimens by means of tensile tests at 25 and −76°C. The results showed that low carbon specimens (C ≃ 10 ppM) were extremely low in ductility due to an intergranular brittleness when the average grain diameter in the transverse cross section of the specimen ($\bar{d}_T$) was larger than about 0.04 mm, though the specimen showed a large ductility when $\bar{d}_T$ was smaller than 0.04 mm. At −76°C, the ductility of medium carbon specimens (C = 80 ppM) increased with increasing $\bar{d}_T$ when $\bar{d}_T$ was larger than about 0.08 mm. In high carbon specimens (C = 210 ppM) the ductility increased nearly linearly with increasing $\bar{d}_T^{-1/2}$. When $\bar{d}_T$ was larger than about 0.04 mm, both the medium and high carbon specimens were more ductile than the low carbon specimen. The most ductile was the medium carbon specimen which was free from the intergranular brittleness and also from coarse carbides. When $\bar{d}_T$ was smaller than 0.04 mm, the ductility of the low carbon specimen was as large as, or slightly larger than, that of the high carbon specimen. However, it could not be concluded whether carbon increases or lowers the ductility in an equiaxed fine grained molybdenum because of a uniaxed recrystallized structure of the low carbon specimen. (auth)

Radiation Effects

Refer also to abstract 25972.

26119 (N-71-36885) RADIATION EFFECTS DESIGN HANDBOOK. SECTION 7. STRUCTURAL ALLOYS. Kangilaski, M. (Battelle Memorial Inst., Columbus, Ohio. Radiation Effects Information Center). Oct 1971. Contract NASw-1568. 151p. (NASA-CR-1873). NTIS.

Summary information is presented on the effects of radiation on structural alloys. The radiation form is neutrons with a small amount of gamma information. Information is included on aluminum, beryllium, magnesium, titanium, zirconium, various steels, and refractory metals. Some cryogenic work is also discussed. (auth) (STAR)

26120 ELECTRON MICROSCOPY OF RADIATION DAMAGE IN COPPER PRODUCED BY HEAVY IONS IN THE keV ENERGY RANGE. Haeussermann, F. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phil. Mag.; 25: No. 3, 537-59(Mar 1972). (In German).

Thin copper foils were irradiated with copper and gold ions in the energy range 4 keV ≤ E ≤ 70 keV with doses $D \leq 7 \times 10^{12}$ ions/cm^2 and investigated by means of transmission electron microscopy. At ion energies E ≥ 6 keV vacancy-type defects were produced, the structure of which depended on the ion energy; defects with isotropic displacement field, Frank loops, extended Frank loops and multiple clusters were observed. These observations can be understood in terms of the depleted zone model. The defect production rate depended on energy and mass of the ions and reached, after gold ion irradiation, the magnitude 0.5 at about 25 keV. Channeling effects influenced the defect production rate differently in different energy ranges. The clustering efficiency in copper was also a function of the ion energy and had values between 0.25 and 0.5. Similar clustering efficiencies have been reported in the literature for gold after xenon ion irradiation. (auth)

26121 STUDY OF THE RADIATION DAMAGE PRODUCED BY ENERGETIC GOLD IONS IN MOLYBDENUM AND TUNGSTEN. Haeussermann, F. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phil. Mag.; 25: No. 3, 583-98(Mar 1972).

Thin molybdenum and tungsten foils with different purities, irradiated at room temperature with gold ions in the energy range 20 keV ≤ E ≤ 70 keV and with doses $D \leq 5 \times 10^{13}$ ions/cm^2, were investigated by means of transmission electron microscopy. Under the above irradiation conditions vacancy-type dislocation loops with Burgers vectors a/2⟨111⟩ were produced. The defect production rates in molybdenum and tungsten were in general appreciably smaller than in the f.c.c. metals copper and gold; they depended on the direction of the ion beam, on the foil

orientation and on the purity of the material. Channeling effects were studied by irradiating simultaneously W/Cu- and Mo/Cu-specimen pairs. From these experiments an absorption parameter for gold ions in tungsten channels of 0.08/ξ and an energy loss of gold ions in tungsten channels of 14 eV/Å were determined. (auth)

26122 KINETICS OF DISSOLUTION OF STEEL 45 WITH INDUCED RADIOACTIVITY AND OF HYDROGEN DIFFUSION THROUGH SPECIMENS IN MINERAL ACIDS. Laptev, N. Ya.; Balezin, S. A.; Spitsyn, V. I.; Kuleshov, I. M. Uch. Zap., Mosk. Gos. Pedagog. Inst.; No. 303, 60-5(1969). (In Russian).

The effects of induced radioactivity on the corrosion of steel 45 and hydrogen diffusion through specimens in mineral acids were determined. Specimens with a specific radioactivity of 3.5 to 4 mCi/g corroded much more slowly in sulfuric and perchloric acids and slightly faster in hydrochloric acid as compared with nonradioactive specimens. Such a reduction in corrosion rate occurs only in the presence on the metal surface of corrosion products, due to the formation of a positive charge on this film during β-irradiation. (Corrosion Control Abstr.)

26123 MODEL FOR SWELLING UNDER IRRADIATION. Gomolinski, M.; Brebec, G. (Centre d'Etudes Nucleaires, Saclay, France). J. Nucl. Mater.; 43: No. 1, 59-71(Apr 1972). (In French).

A quasi chemical model has been worked out to account for the swelling of irradiated materials. This model resembling in principle that of Harkness and Che Yu Li differs from the latter in the following ways: an empirical nucleation law for cavities and loops is used, the critical radius of the nucleus is calculated more realistically by taking into account the interstitials, the calculation of the void size distribution curves is improved, and finally the equilibrium vacancy concentration near the sinks is considered. Calculated values of swelling were compared with experimental results in Al, Mg, and Cu. The influence of various parameters such as temperature, dose rate, dose, and cold work was investigated in Al. The swelling was quite well described by this model but the calculated void size distribution curves were very different from the experimental observations mainly at high temperature. The disagreement may be due to coalescence. (auth)

26124 ANALYSIS OF DISLOCATION LOOPS IN TUNGSTEN PRODUCED BY 60 keV ION IRRADIATION. Haeussermann, F. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phil. Mag.; 25: No. 3, 561-81(Mar 1972). (In German).

Thin tungsten foils were irradiated at room temperature with 60 keV gold ions and investigated by means of transmission electron microscopy. It was demonstrated that the method used so far for the study of radiation damage in fcc metals (I-analysis) is in many cases not adequate for the investigation of small defect clusters in bcc metals. Using ion-irradiated tungsten as an example it is shown how to identify Burgers vectors and habit planes of the defects by means of contrast experiments (contrast figures of threefold symmetry are especially discussed). In tungsten the energetic ions produced Frank loops with Burgers vectors a/2⟨011⟩ which transformed immediately into glissile dislocation loops with Burgers vectors a/2⟨111⟩ by a shear process within the habit plane (shear vector a/2⟨001⟩). These glissile dislocation loops were attracted to the nearby surface and partly left the foil. A small fraction of the dislocation loops had Burgers vectors a/2⟨011⟩; there was no evidence for defects with Burgers vectors a⟨001⟩. (auth)

Other Materials

Refer also to abstract 26830.

26125 (AAEC/LIB-Bib-324) EFFECT OF RADIATION ON EPOXY COMPOUNDS. A Bibliography. Literature search, 1962–1971. Geue, Jean (comp.) [Australian Atomic Energy Commission Research Establishment, Lucas Heights]. Jan 1972. 26p. Dep. NTIS (U. S. Sales Only).

One hundred thirty-eight references are cited covering the period 1959 to 1971. Items are listed chronologically by year and alphabetically by author within each year. A citation is made of an abstract for each reference. (Australia)

26126 (BNL-16578) REVIEW OF PROPERTIES OF POLYMER IMPREGNATED CONCRETE. Auskern, Allan (Brookhaven National Lab., Upton, N. Y.). Jan 1972. 48p. (CONF-711214-1). Dep. NTIS.

From Conference on new materials in concrete construction; Chicago, Ill. (Dec 1971).

Incorporating a relatively small amount of a polymer in cured concrete or mortar alters the nature of the original material dramatically. A new and different structural material results with properties only remotely related to the starting materials. The properties reported were developed from a very limited number of concretes. As work progresses on understanding the basic interactions between the cement, aggregate, and polymer phases, it should be possible to formulate polymer impregnated concretes with specific properties, just as it is now possible to formulate normal concretes with specific properties. It is doubtful that the ultimate properties of PIC have been achieved. If, as seems likely, there are further improvements in the mechanical properties of PIC, a material will have been derived from concrete without concrete's poor tensile strength. Attempts to develop techniques for incorporating the monomer or polymer in the concrete mix rather than the cast concrete have been unsuccessful. Also, there has been little work done in impregnating existing concrete structures. So for the present, PIC is limited to precast concrete shapes. In the decision of a concrete manufacturer to produce PIC, he must carefully evaluate the additional expense of installing the necessary monomer handling, impregnation, and polymerization equipment against the potential market for a new material derived from concrete with unique structural and durability properties. (auth)

26127 METHOD OF FORMING A THERMAL EMISSIVITY COATING ON A METALLIC SUBSTRATE. Monroe, James E. Jr. (to United States Atomic Energy Commission). U. S. Patent 3,620,808. 16 Nov 1971. Filed 5 Jan 1968.

A method of forming a thermal emissive coating having an E = 0.8 or higher on a metallic substrate comprises preparing the surface of the substrate by cleaning and roughening, coating the prepared surface of the substrate with a first coat of nickel aluminide, and coating the first coat with an additional coat forming a compositional gradient from decreasing amounts of nickel aluminide and increasing amounts of a material selected from the group consisting of Al_2O_3, $CaOTiO_2$, Ir, $FeOTiO_2$, NiO, and $CaTiO_3$. (B.L.M.)

26128 THERMOELECTRIC COMPOSITIONS AND DEVICES UTILIZING THEM. (to RCA Corp.). British Patent 1,260,718. 19 Jan 1972. Priority date 2 Apr 1968, United States.

A thermoelectric device is made up of two thermoelectric circuit members, one member being an N-type and the other being a P-type, joined conductively to form a thermoelectric junction. The N-type element comprises an alloy of 84.97 to 98.8 mol % lead telluride; 1 to 15 mol % germanium telluride and/or germanium selenide; and 0.03 to 0.20 mol % of a conductivity modifier consisting of one of the following, lead iodide, germanium tetrabromide, germanium tetraiodide, lead bromide, an equimolar mixture of lead and lead iodide, an equimolar mixture of lead and lead bromide, or an equimolar mixture of germanium and germanium tetrabromide. (B.L.M.)

26129 IMPROVEMENTS RELATING TO RADIATION SHIELDS. Vogel, Reinhard Ernst; Marxen, Friedrich. British Patent 1,260,342. 12 Jan 1972. Priority date 6 Sep 1968, United States.

A material having a shielding effect against radiation, particularly γ and neutrons, consists of rubber (natural or synthetic) or some polymerizable material, 10 to 60 wt % of a saturated fatty acid that is a solid at room temperature and that has at least 9 C atoms distributed throughout and intimately mixed with the polymer; and at least one metal or compound of the metal selected from the group consisting of Pb, Bi, W, Zr, Fe, Sn, Cd, Li, or Ba. (B.L.M.)

26130 DEFORMATION OF IRRADIATED SINGLE CRYSTALS OF POLYETHYLENE. Andrews, E. H.; Voigt-Martin, I. G. (Queen Mary Coll., London). Proc. Roy. Soc. (London), Ser. A; 327: No. 1569, 251-67(7 Mar 1972).

Polyethylene single crystal lamellae and lamellar stacks were deformed on an extensible substrate after exposure to doses of γ radiation from 0 to 210 MR in vacuo, and examined in the electron microscope. Unirradiated crystals deformed affinely with the substrate by a variety of crystallographic processes including slip, twinning and a strain-induced phase change. Irradiation produced intra-lamellar crosslinking, which inhibited affine deformation by the suppression of slip, but deformation by (110) twinning persisted because it involved only very small movements of the molecular chains. A new deformation mechanism was found in the irradiated crystals, namely the nucleation and growth of microcracks by shear on the (200) and (020) planes of the lamellar crystal. This phenomenon is tentatively attributed to dislocation pile-up at crosslinking sites. (auth)

26131 ELASTIC CONSTANTS AND GRUENEISEN PARAMETERS OF PYROLYTIC GRAPHITE. Gauster, W. B. (Sandia Labs., Albuquerque, N. Mex.). Phil. Mag.; 25: No. 3, 687-700 (Mar 1972).

The room-temperature elastic constants of a pyrolytic graphite were measured by an ultrasonic transmission technique and compared with values calculated on the basis of the constant strain and

constant stress models from the elastic constants of compression-annealed pyrolytic graphite (CAPG). It was found that the constant stress model gave better agreement, and that the measured C_{11} and C_{44} could be bracketed by calculations with the basal plane shear constants of neutron-irradiated and unirradiated CAPG, respectively as inputs, as would be expected because of the high mobility of dislocations in the basal plane. Grüneisen parameters, for sample temperatures between 80° and 300°K, were determined from measurements of inertial thermoelastic stress. Calculations from single-crystal thermal expansion and elastic constant values showed reasonable agreement with the measured parameters and indicated that the elastic constants of a given pyrolytic graphite, being extremely structure sensitive, can be used to estimate Grüneisen parameters from single-crystal data. (auth)

26132 PROCESS FOR IRRADIATING SYNTHETIC RUBBER TO IMPROVE GREEN STRENGTH. Gracia, Albert J.; Reilly, Patrick J.; Walters, Sandra J. (to Goodyear Tire and Rubber Co.). U. S. Patent 3,644,186. 22 Feb 1972. Filed 27 Jun 1968.

The green strength of synthetic cis-1,4-polyisoprene is increased to levels equivalent to those of natural rubber by irradiating the polyisoprene with 0.1 to 6.0 Mrads. (Official Gazette)

26133 ELECTRON BEAM EXPOSURE OF POLYMERIC RESISTS. Sobanski, J.; Chabicovsky, R.; Schuler, A. (Technische Hochschule, Vienna). J. Vac. Sci. Technol.; 9: No. 1, 358-60(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

Two types of polymeric resists were exposed to pulsed electron beams under the following conditions: accelerating voltage 26 to 34 kV, beam current 10^{-4} A, pulse length 4 μsec to 16 msec. The exposure latitudes of thin layers of polystyrene and poly(methyl methacrylate) were studied. These polymers are well qualified as, respectively, negative and positive acting resists. However, poly(methyl methacrylate) with an average molecular weight below 20,000 is not resistant to etchants because of the pin-hole formation during developing. (auth)

26134 ADSORPTION OF CARBON MONOXIDE AND HYDROGEN ON GRAPHITE. Beitel, George A. (Midwest Research Inst., Kansas City, Mo.). J. Vac. Sci. Technol.; 9: No. 1, 370-2(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass (11 Oct 1971).

Adsorption of carbon monoxide and hydrogen was investigated on three graphites: a high-density pyrolytic graphite, a small-grain extruded graphite, and a processed pyrolytic-graphite tape. Adsorption was investigated in the high vacuum range $10^{-9} < P < 10^{-5}$ torr. The sticking probability of CO was found to have a maximum value of 4.7×10^{-5} which decreased rapidly as the average surface coverage approached 0.01 monolayer. Lower sticking probabilities were observed on the highly oriented pyrolytic graphite which indicated that adsorption occurs principally on the edge atoms. Graphite which had been outgassed to T < 1850°K exhibited an apparent sticking probability as high as 4×10^{-5} for H_2. The sticking probability for H_2 on graphite which had been outgassed at 2400°K was found to be $<10^{-8}$. (auth)

26135 NUCLEAR MAGNETIC RESONANCE STUDIES OF CHARACTERIZATION AND RADIATION DAMAGE KINETICS OF POLYMERS. Trexler, Frederick David. University Park, Pa.; Pennsylvania State Univ. (1971). 177p. University Microfilms Order No. 72-9541.

Thesis.

The applicability of broad line nuclear magnetic resonance spectroscopy (NMR) to the study of thermal and dose rate kinetics of radiation damage has been demonstrated. In organic systems, such as polytetrafluoroethylene (Teflon), small "structural" changes affecting molecular motion were detected by NMR and followed as functions of dose rate and temperature. Vacuum sealed rods of Teflon and polyethylene were irradiated up to 3.9 and 20 Mrad, respectively with 1.25 MeV gamma rays; radiation intensities ranged from 8.5×10^4 to 1.7×10^6 roentgen per hour. The ratio, A_0/A, of first derivative NMR spectra peak amplitudes was chosen to represent the change from standard to irradiated sample; consistent increase with dose was found in the case of Teflon. An empirical equation relating A_0/A to the absolute temperature, T, the absorbed dose rate in photons per second, r, and the irradiation time in seconds, t, was derived. From this an empirical equation was obtained giving the time for constant damage in the form $\ln t_c = C_1 + E_a/RT + (C_2 + E_a^*/RT) \ln r$ where $C_1 = 25.24$, $C_2 = -0.845$, $E_a = 3.43$ kcal/mole, $E_a^* = -40.8$ cal/mole and R is the molar gas constant. This corresponds to the modified Arrhenius kinetics relation $d/dt(A_0/A) = k_0 r^{C-E_a^*/RT} e^{-E_a/RT}$ in which the radiation rate is the frequency factor with a temperature-dependent exponent. A theoretical significance was found for the empirical parameters. The prime activation energy, E_a, was explained in terms of the thermal relaxation of a cage effect with subsequent mobility-limited regrouping of the radiation-degraded molecular chains. Both lead to the observed NMR line width increase and peak amplitude decrease with increased temperature during irradiation. The small negative value of E_a^* was introduced as a thermal correction term to the radiation rate. This was indicative of competing effects represented by the "reverse" reactions such as the recombination of abstracted fluorine with free radicals. A given radiation dose effected the most change at high temperatures and low dose rates. Extrapolation from a set of test conditions to predict lifetimes of organic materials in radiation fields must take account of similar kinetics. As compared to Teflon, polyethylene exhibited anomalous effects of low and high dose rates on the characteristic narrow and broad NMR peaks, which arise from the amorphous and crystalline regions, respectively. This prevented the deduction of a kinetic interpretation along the lines adopted for Teflon. However, appropriate explanations have been offered for the anomalous behavior. The applicability of NMR was established for characterizing plasticized poly (vinyl chloride) polymers and well-fractionated polystyrenes of various molecular weights. (Diss. Abstr. Int., B)

26136 METHOD OF PAINTING. (to Ford Motor Co. Ltd.). British Patent 1,264,552. 23 Feb 1972. Priority date 1 Jul 1968, United States.

A method of coating a surface is described in which one or more vinyl monomers are deposited on the surface in solution in polymers. The polymers are reaction products of acryloyl or methacryloyl halide with a hydrolyzed polyvinyl acetate or hydrolyzed copolymer of vinyl acetate with an ethylenically unsaturated monomer. The selected combination is cured using electron beams. (J.R.D.)

26137 PAINTING POLYOLEFINS. (to Ford Motor Co. Ltd.). British Patent 1,264,579. 23 Feb 1972. Priority date 4 Aug 1969, United States.

A method is described in which the adhesion of a paint binder comprising a vinyl resin or vinyl resin together with a monovinyl monomer to a polyolefin substrate is unexpectedly and markedly improved if the paint binder contains at least 15 wt % of certain acrylates and the film is polymerized upon the polyolefin surface with a beam of electrons with an average energy of from 100,000 to 500,000, preferably from 150,000 to 450,000 electron volts. The polyolefin refers to polyethylene, polypropene, and ethylene–propene copolymers. (J.R.D.)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

26138 AUSTRALIA IN THE NUCLEAR AGE. Bellany, Ian. Sydney; Sydney University Press (1972). 144p.

The technical, political, and economic aspects of the possible acquisition of nuclear weapons by Australia are examined. In addition to exploring the range of strategic questions raised by the acquisition of a nuclear force by Australia, the circumstances under which Australia might decide to become a nuclear power are considered with respect to the obstacles that lie in the way of such a decision, and to the alternative choices. Commercial features of nuclear power including the technology of uranium enrichment are described. It is concluded that Australia can accommodate the tenets of the Non-Proliferation Treaty while making use of existing mechanisms of international cooperation in nuclear technology and concurrently develop national competence in this field of industrial activity which could be utilized if it were felt that a nuclear force would add to national security. A text of the NPT is included together with extracts of the Treaty for the Prohibition of Nuclear Weapons in Latin America, a discussion of the IAEA safeguards system and a world list of nuclear power plants. (Australia)

Accountability and Safeguards

26139 (KFK-1106) ANALYSIS OF SOME AVAILABLE DATA ON MATERIAL UNACCOUNTED FOR (MUF). Singh, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Apr 1971. 41p. Dep. NTIS (U. S. Sales Only).

More than 200 values for material unaccounted for (MUF) in different nuclear facilities, published in the literature, were analyzed with a view to determine whether: they can be explained by systematic errors of measurements alone; they follow any known statistical distribution; and the absolute or the normalized values of MUF are better safeguards indicators. The analysis shows that within the restraints stipulated, a major part of the MUF data can be explained by systematic errors of measurements but a large number of other random and nonrandom factors contribute also to the MUF values. Specific MUF values for a facility may show a normal distribution. Normalized MUF values with respect to the total input appear to be a better safeguards indicator than the absolute values. Continuous analysis of MUF values obtained under controlled conditions is essential for the proper use of these values. (auth)

Disposal and Storage

Refer also to abstract 25380.

26140 DISPOSAL OF THE RADIOACTIVE WASTES AT THE TRISAIA NUCLEAR RESEARCH CENTER. Marzocchi, A. (CRN, Trisaia, Italy); Cassano, G.; Gera, F.; Lenzi, G. Minerva Fisiconucl.; 15: No. 1, 38-45 (Jan-Mar 1971). (In Italian).

The method of classification, collection, and treatment of solid and liquid wastes produced at the Trisaia Nuclear Research Center is discussed. The problem caused by the possible migration of radionuclides due to the chronic or accidental loss either from the pits for solid wastes or from liquid containers in the sea is examined in detail. (tr-auth)

26141 RADIOACTIVE WASTE MANAGEMENT PRACTICES IN WESTERN EUROPE. Paris; European Nuclear Energy Agency (1971). 126p. $3.25.

The principles and practices applied to radioactive waste management in Western Europe are reviewed. The origin and different types of radioactive wastes are discussed, and data on the production of gaseous, liquid, and solid radioactive wastes in Western Europe during 1970 are presented. The general safety, technical, and economic aspects of waste management are reviewed. Specific treatment and storage practices at various European nuclear facilities and the outstanding waste management problems, notably safe permanent storage of high-level liquid wastes and the control of ^{85}Kr and tritium releases to the atmosphere, are described. It is concluded that: the International Commission on Radiological Protection recommendations have resulted in very high basic standards for safety in radioactive waste management; if the radiation exposure of man is kept within permissible levels, long-term laboratory and field experiments show no evidence of ecological damage and therefore the dose rate to man should remain the limiting safety factor for waste management; and, considering the past performance of waste management practices in Western Europe and of methods for assessing the associated radiation hazards, the optimum development of nuclear energy need not be impeded by radioactive waste management problems which will have to be dealt with in the future. (L.C.L.)

Handling Equipment and Procedures

26142 (ORNL-TM-3469) CRITICALITY ANALYSIS: LWBR ASSISTANCE PROGRAM IN BUILDING 3019. Horton, R. W. (comp.) (Oak Ridge National Lab., Tenn.). Mar 1972. Contract W-7405-eng-26. 139p. Dep. NTIS.

Equipment items used for handling ^{233}U in the LWBR program assistance effort in Building 3019 at the Oak Ridge National Laboratory were analyzed to define the criticality control methods to be applied. The dimension, function, and location of each item are stated, and the primary criticality control parameter is identified; secondary control methods are also specified for each item. The data found in standard literature references were used as a guide in most cases. Special calculations were made for cases in which the literature does not apply directly or does not define the limits as closely as plant conditions require. (auth)

26143 (ORNL-TM-3567) SAFETY ANALYSIS: LWBR SUPPORT PROGRAM IN BUILDING 3019 PILOT PLANT. Horton, R. W. (comp.) (Oak Ridge National Lab., Tenn.). Mar 1972. Contract W-7405-eng-26. 99p. Dep. NTIS.

The hazards associated with the preparation of kilogram quantities of $^{233}UO_2$ powder in the ORNL Building 3019 Pilot Plant in support of the Light Water Breeder Reactor program are recognized as those related to handling large quantities of fissile material (criticality), those stemming from handling alpha-active material (contamination-radiation), the danger of fire and explosion stemming from handling hydrogen and solvents and, lastly, the toxicity of the materials. The criticality hazard is evaluated in a separate report; the remaining hazards are evaluated and the measures that have been taken to eliminate and/or minimize each are described. (auth)

26144 DEVICE FOR POSITIONING IRRADIATED CAPSULES RELATIVE TO THE REACTOR CORE. Descamps, Jean-Marie (to Commissariat a l'Energie Atomique). French Patent 2,065,641. 6 Aug 1971. Filed 12 Sep 1969. (In French).

A device for positioning irradiated capsules relative to the core of a swimming pool reactor is described. This device assures the precise lateral positioning and the easy cooling of the capsule in every position by circulating water. The device takes up very little lateral space and enables the optimum use of the available irradiation space. (France)

26145 EQUIPMENT FOR SAMPLING LIQUIDS, IN PARTICULAR RADIOACTIVE LIQUIDS. Conche, Francois; Duboz, Jacques; Guilloteau, Rene; Pillerault, Jean (to Commissariat a l'Energie Atomique). French Patent 2,058,751. 3 May 1971. Filed 24 Sep 1969. (In French).

Equipment for sampling liquids is described; it consists of a glove box with a base provided with means for accommodating several hollow pins, each destined to be plunged into a reservoir. The tool holder is provided with three tools; a withdrawal device, a sample selector, and a device for disassembling and reassembling the pins. The assembly is remotely controlled. The sample is very representative because of the continuous circulation of the liquid in the equipment. (France)

Transportation

26146 IMPROVEMENTS IN OR RELATING TO CONTAINERS FOR TRANSPORTING RADIOACTIVE MATERIAL. Sidebotham, Ernest William; Jackson, Alan (to United Kingdom Atomic Energy Authority). British Patent 1,266,684. 15 Mar 1972. Filed 8 Jul 1968.

Reference is made to the design of heat-dissipating fins on irradiated fuel transport containers. The fins described incorporate shielding material and are inclined to the normal to the body of the container. The fins are preferably inclined in two directions and are sufficiently closely spaced that radiation, in addition to having to pass through the body of the container, has to pass through at least two thicknesses of fin material. A suitable detailed design of fin is described. (UK)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 25650.

26147 (HMI-B-118) VICKSI: PROPOSAL FOR A VAN DE GRAAFF-CYCLOTRON COMBINATION FOR ACCELERATION OF MEDIUM HEAVY IONS. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Jan 1972. 54p. (In German). Dep. NTIS (U. S. Sales Only).

To accelerate heavy ions of mass A ≥ 40 to 200 MeV it is proposed to install a separated-magnet cyclotron. The existing 7 MV Van de Graaff will be used as injector. Beams of 100 particle nA are anticipated with an energy resolution of 10^{-3}. The facility will deliver beams in a range of ion mass and energy that has not been well covered so far. This will allow to systematically investigate a broad range of problems in nuclear, atomic, and solid-state physics. Cost estimates are presented. (auth)

26148 (JINR-P16-6182) CALCULATION, BY THE MONTE-CARLO METHOD, OF SPECTRAL DISTRIBUTIONS OF SCATTERED NEUTRON RADIATION FROM HIGH-ENERGY ACCELERATORS. Kimel, L. R.; Rastsvetalov, Ya. N.; Sidorin, V. P.; Khvostov, V. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

The data on the spectral distributions of scattered neutrons in air from the point monodirectional radiation sources are obtained by the Monte-Carlo method. The data can be used for the scattered radiation field calculations from high-energy accelerators. (auth)

26149 (JINR-P16-6185) METHOD FOR CALCULATION OF RADIATION FIELD AROUND HIGH-ENERGY ACCELERATORS. Zaitsev, L. N.; Rastsvetalov, Ya. N.; Sidorin, V. P.; Khvostov, V. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The method for calculation of the radiation field around high-energy accelerators is presented. The calculation results are compared with the data on the radiation field measurements from the JINR synchrophasotron and other accelerators. (auth)

26150 (NRL-Memo-2402) REPORT OF LINAC OPERATION, 1 JANUARY-31 DECEMBER 1971. Interim Report No. 12. Godlove, T. F. (ed.) (Naval Research Lab., Washington, D. C.). Jan 1972. 30p.

The operation and use of the NRL 60-MeV Linac are described for the period 1 January-31 December 1971. Highlights of the basic and applied research program are reviewed including electron scattering, neutron-capture γ-ray measurements, and a number of applications. Total time for the period was 3697 hours, divided into 2992 hours for beam and set-up time (including 302 hours for outside users), 560 hours devoted to maintenance and improvements, and 145 hours lost to breakdowns. A bibliography is included, as are brief descriptions of linac use by other groups. (auth)

26151 (RHEL/R-239) NIMROD OPERATION AND DEVELOPMENT. Quarterly Report, October 1-December 31, 1971. Gray, D. E. (ed.) (Rutherford High Energy Lab., Chilton (England)). Jan 1972. 20p. Dep. NTIS (U. S. Sales Only). UK 30 pence.

The use of the Nimrod accelerator beam for high energy physics research during the quarter is reported with a description of the unique track sensitive H target facility on the 1.5 m cryogenic bubble chamber. (UK)

26152 100 keV HEAVY ION ACCELERATOR FOR IMPLANTATION STUDIES. Benoit, R.; Bertolini, G.; Cappellani, F.; Restelli, G. (EURATOM-CCR, Ispra, Italy). Nucl. Instrum. Methods; 99: No. 2, 421-4(1972).

An ion implanter was designed and constructed at the CCR-ISPRA. The equipment enables implants to be carried out at energies ranging from 0 to 100 keV with a wide range of ion species and choice of target temperature and orientation. (3 figures) (auth)

Auxiliaries and Components

26153 (IFVE-INZH-71-7) CREATION OF HIGH VACUUM IN THE CAVITIES OF THE LINAC I-100, AN INJECTOR OF THE PROTON SYNCHROTRON. Basalaev, M. I.; Il'evskii, S. A.; Mirzoev, K. G.; Rogozinskii, V. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 26p. (In Russian). Dep. NTIS (U. S. Sales Only).

The high-vacuum part of the linac is briefly described, and a method of degasing and creating a high vacuum in the cavities is presented. Having carried out a 400 to 600 hour heat test, the purpose of which was to clean the cavities from organic impurities that appeared in the course of surface treatment and during cleaning of the electrical discharge titanium pump NEM-1T with argon, a vacuum of 5.10^{-7} torr was obtained. After about 20 hours of vacuum pumping starting from atmospheric pressure, a vacuum of 2.10^{-6} torr was obtained. (auth)

26154 (INR-1353) ENERGY STABILIZER OF 30-MeV BETATRON. Burzynski, Zygmunt; Leszczynski, Michal; Rodek, Jan (Institute of Nuclear Research, Warsaw (Poland)). 1971. 10p. (In Polish). Dep. NTIS (U. S. Sales Only).

The arrangement used to determine and control the operating energy of a 30 MeV betatron is described. The system is based on a measurement of the orbit flux to determine the momentum of the electrons at the instant orbit contraction is initiated. The method enables easy compensation of the temperature fluctuations of the tunnel diode circuit used as a reference for energy control. An estimated calibration curve for the betatron energy control system is given. (auth)

26155 (KFK-1493) PONDEROMOTIVE STABILITY OF HIGH-FREQUENCY RESONATORS AND RESONATOR REGULATING SYSTEMS. Schulze, Dietrich (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Dec 1971. 174p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Karlsruhe Univ. (West Germany).

Linear and nonlinear stability conditions for an RF-cavity exposed to large ponderomotive (electromagnetic) forces are derived and discussed. Stabilization techniques using amplitude and phase control loops are investigated. It is shown, that ponderomotive stability can be insured by proper choice of control parameters. Under certain conditions ponderomotive forces can damp mechanical oscillations induced by external sources. The calculated stability thresholds, the effectiveness of stabilizing and the damping property of the electromagnetic field could be confirmed experimentally. These experiments were carried out with a superconducting helically loaded resonator within construction of a superconducting proton linear accelerator at Karlsruhe. (auth)

26156 (KFK-1505) DEFLECTOR STRUCTURES FOR A SUPERCONDUCTING PARTICLE SEPARATOR. Bauer, Walter (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Dec 1971. 78p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Karlsruhe, Ger.

The extension of the rigorous theory of uniform, periodic, iris-loaded deflectors to standing-wave $\pi/2$-mode biperiodic cavities is presented. It is possible to find conditions for the geometry necessary to enforce confluence in the $\pi/2$ mode. The Q value and transverse shunt impedance are also computed, and good agreement with the few published results is found. A deflection test measurement of a lead-plated, superconducting cavity of about 0.5 m length using 1-MeV electrons from a radioactive beta source yielded a transverse interaction parameter $R_t/Q = (0.43 \pm 0.07)\ k\Omega/m$, in reasonable agreement with the theoretical value. Room temperature measurements resulted in a final geometry which gives the required resonance frequency of 2.855 GHz and a solution for the problem of mode stabilization: a difference of 5.8 mm between the two diameters of an elliptically formed cavity detunes the 90° rotated mode by 50 MHz. (24 figures, 12 tables, 51 references) (auth)

26157 (NP-19180) SLOW EXTRACTION IN THE PROGRAM PLAN FOR IMPROVEMENT OF THE CERN SYNCHRO-CYCLOTRON. Mandrillon, P. (Universite Scientifique et Medicale de Grenoble (France)). 1971. 89p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The present improvement program at the CERN synchro-cyclotron has as its objectives the improvement of the number of protons accelerated per cycle, the repetition rate, and the beam quality. The object of the work described is the study of

the systems which will be used in the improved machine for slow extraction of the beam with a high duty-cycle. The improvement program and the problem of extraction are first discussed in general. The components necessary for regenerative extraction are described in detail; these include the C, the slow extraction bobbin, and the regenerator. Other components of the extraction system are mentioned briefly. (43 figures, 4 tables) (R.W.R.)

26158 EQUILIBRIUM CHARGE STATE DISTRIBUTIONS OF OXYGEN AND SULFUR IONS IN THE CARBON STRIPPER OF A TANDEM ACCELERATOR. Ambros, R.; Kleinfeld, A. M. (Univ., Cologne). Nucl. Instrum. Methods; 99: No. 2, 173-77(1972).

The equilibrium-charge-state distributions of oxygen and sulfur ions after passing through the carbon stripper of an FN tandem Van de Graaff were measured. The measurements were performed over the following range of terminal potentials: 3.6 to 8.8 MV for oxygen and 4.6 to 7.6 MV for sulfur. (5 figures, 2 tables) (auth)

26159 VACUUM PROBLEMS ON A 5-GeV ELECTRON SYNCHROTRON. Halliday, B. S.; Trickett, B. A. (Daresbury Nuclear Physics Lab., Eng.). J. Vac. Sci. Technol.; 9: No. 1, 42-5(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

A number of problems arise in the design, commissioning, and subsequent running of the vacuum system of a large synchrotron. The problems dealt with are (a) high water desorption from ferrite materials, (b) the use of a data logging computer for ion pump starting and pressure monitoring, (c) the protection of the system due to turbomolecular pump set failure when running unattended, (d) the reconditioning of ion pumps, and (e) radiation damage to early design vacuum chambers and outgassing due to synchrotron radiation. (auth)

26160 VACUUM SYSTEM OF THE SUPERCONDUCTING LINEAR ACCELERATOR AT KARLSRUHE. Flecher, P. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). J. Vac. Sci. Technol.; 9: No. 1, 46-9(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

A 60-MeV superconducting proton accelerator is now being constructed at Karlsruhe as a pilot project for a larger accelerator. This paper discusses vacuum aspects of a superconducting linac in regard to surface contamination, sparking, radiation damage, etc., and presents a brief description of the pilot cryostat and gives some experimental results. Special features of the cryostat are the use of a two-vacuum system in which no uhv flange has any contact with superfluid helium and the use of cooled ion pumps as an integral part of the rf structure. (auth)

Ion Sources, Injection, and Extraction

26161 (ANU-P-537) 14 UD INJECTION SYSTEM: SINGLE OR DOUBLE FOCUSING MAGNET? Huang, F. C. P.; Treacy, P. B. (Australian National Univ., Canberra. Research School of Physical Sciences). [1971]. 11p. Dep. NTIS (U.S. Sales Only).

An alternative to the present proposed injection system for the 14 UD accelerator is suggested, which has the advantages of easy focusing, complete astigmatism and a resolution dependent entirely on externally controlled slits. (Australia)

26162 ATOMIC BEAM SCATTERING IN POLARIZED ION SOURCES. Singh, J. (Panjab Univ., Chandigarh, India). Nucl. Instrum. Methods; 99: No. 2, 413-18(1972).

The scattering between atoms having velocities lower and higher than the average velocity in a beam is discussed theoretically. These results were observed experimentally at the Polarized Deuteron Source at Birmingham University Cyclotron. On the basis of this investigation some modification was done in the Birmingham source. (7 figures, 1 table) (auth)

26163 LOW-PRESSURE ION SOURCE. Fitch, R. K.; Rushton, G. J. (Univ. of Astron, Birmingham, Eng.). J. Vac. Sci. Technol.; 9: No. 1, 379-82(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

This electrostatic ion source operates as a cold cathode device. It produces a beam of energetic positive ions of, for example, 100 $\mu A/cm^2$ at a pressure of 5×10^{-4} torr when operated at an anode potential of 10 kV. The ion beam is reasonably well collimated and the ions have a broad energy spectrum. It is therefore most suitable for sputter-ion etching of metallic and nonmetallic specimens for electron microscopy. It is relatively simple to construct and entirely reliable in operation. A number of optical and scanning electron micrographs of etched surfaces obtained with this source are given. (auth)

Ion Optics and Field Calculations

26164 (BNL-16616) EFFECTS OF RANDOM ERRORS IN COIL LOCATIONS IN A HIGH-FIELD SUPERCONDUCTING ACCELERATOR. Parzen, G. (Brookhaven National Lab., Upton, N. Y.). 25 Feb 1972. 8p. Dep. NTIS.

The effects due to magnetic field perturbations caused by random errors in the coil positions in the bending magnets of a high-field superconducting accelerator are investigated. An error in the position of a particular current block in a bending magnet with a cosine current distribution will introduce multipole terms in the median plane magnetic field. Consideration of the random dipole term and its effect on the central orbit leads to a tolerance on the rms error in the location of the current blocks of about 2.5×10^{-3} in. The effects of the random quadrupole term and the nonlinear terms are also considered. (auth)

26165 (JILA-104) TABLES OF FOCAL PROPERTIES OF THREE-ELEMENT ELECTROSTATIC CYLINDER LENSES. Heddle, D. W. O. (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). 15 Oct 1970. 81p.

The focal lengths and other focal properties of three-element lenses consisting of coaxial cylinders of equal diameter separated by distances of 0.1 diameter are listed. (W.H.K.)

26166 (JINR-P9-6284) NONLINEAR EFFECTS IN THE SINUOUS-INSTABILITY OF THE ELECTRON-ION RING. Kazarinov, N. Yu.; Kuznetsov, A. B.; Perel'shtein, E. A.; Rubin, S. B.; Shevtsov, V. F. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

Transverse oscillations of the electron-ion ring are considered taking account of the nonlinearity of the polarization forces. The existence of the nonlinear stationary waves is pointed out as well as nonlinear stabilization of the sinuous-instability in the small supercriticality regime. (auth)

26167 (LBL-564) COMPUTER PROGRAMS FOR ACCELERATORS AND ELECTRONIC CIRCUIT DESIGNS. Colonias, John S. (California Univ., Berkeley. Lawrence Berkeley Lab.). Dec 1971. Contract W-7405-eng-48. 59p. Dep. NTIS.

This is the first of a series of publications intended to assemble under one cover the most important computer programs relative to various major activities in this Laboratory, and thus establish a permanent library of such programs. This publication deals specifically with computer programs relating to accelerator design and electronic circuit design. Each program is described in terms of an abstract, and a table of vital statistics summarizes the most important information relative to that program. (auth)

26168 (UARAEE-117) PROPERTIES OF EDGE FOCUSING BENDING MAGNET SYSTEM. Abdel-Salam, F. W. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Accelerators and Plasma Physics Research). 1971. 19p. Dep. NTIS (U. S. Sales Only).

Convenient matrix calculations for edge focusing bending magnets in the horizontal and vertical cases are presented. Equations for Q-pole lenses and for edge focusing bending magnets are given. The parameters of magnet systems such as object and image distances, focal lengths and magnifications are given to calculate the resulting momentum dispersion and beam trajectories. (auth)

26169 (UARAEE-118) STUDY OF THE PROPERTIES OF MAGNETIC FOCUSING SYSTEMS. Abdel-Salam, F. W. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Accelerators and Plasma Physics Research). 1971. 30p. Dep. NTIS (U. S. Sales Only).

The characteristics of a system consisting of a bending magnet and quadrupole lenses in both horizontal and vertical cases, and in which the field index n is equal to one and also greater than one are investigated. The general case for a magnetic system using matrix calculations is given. The procedure for obtaining the parameters of a bending magnet such as ω which is equal to $\sqrt{1-n}$, and α which is the bending angle is presented. (auth)

26170 COMPARISON OF CALCULATED THIRD-ORDER ABERRATIONS OF A MAGNETIC QUADRUPOLE LENS. Lee-

Whiting, G. E. (Chalk River Nuclear Labs., Ont.). Nucl. Instrum. Methods; 99: No. 3, 609-10(1972).

Discrepancies between expressions for third-order aberration coefficients of a magnetic quadrupole lens of uniform gradient calculated by Smith [Nucl. Instrum. Methods 79: 144(1970)] and by Lee–Whiting [Nucl. Instrum. Methods 83: 232(1970)] are traced to an algebraic error in the work of the former. (1 figure) (auth)

26171 COMPUTER DESIGN AND OPTIMIZATION OF IRON CORED PARTICLE FOCUSING DEVICES. Besev, C. (Uppsala Univ.); Olsen, B.; Colonias, J. S. Nucl. Instrum. Methods; 99: No. 3, 487-507(1972).

A method for the design and optimization of particle-focusing devices is described. A computer program allowing an interactive design using a light pen technique for instruments with or without iron was developed and tested on a lens spectrometer with iron. The computed fields and the focusing properties of that spectrometer compare favorably with those measured. Certain optical properties of the instrument were easily improved by a factor of ten by using the program described. (21 figures, 2 tables) (auth)

26172 WAVE FUNCTION OF A CHARGED PARTICLE IN CROSSED ELECTROSTATIC AND ALTERNATING MAGNETIC FIELDS. Pavlenko, Yu. G.; Dement'ev, A. S. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 152-4(1971). (In Russian).

The motion of an electron in a homogeneous variable magnetic field was considered, assuming certain magnetic and electrostatic vector potentials. The change in the magnetic intensity, the radiational wave function for a stationary state, Green's function, and a summation formula for two Laguerre polynomials are employed in the mathematical treatment leading to the radiational wave function of an electron in the crossed electrostatic and variable magnetic fields. (K.S.W.)

Storage Rings

26173 DIFFUSION OF PARTICLE SPINS IN STORAGE ELEMENTS. Derbenev, Ya. S.; Kondratenko, A. M. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 62: No. 2, 430-43(Feb 1972). (In Russian).

Depolarization effects due to scattering of the trajectories of particles moving in an electromagnetic field are investigated. The source of stochastization of the orbital motion of the particles may be radiation quantum fluctuations, collisions with the residual gas etc. Formulas are derived which can be employed for finding the particle spin diffusion rate in an arbitrary field storage element. (auth)

Experimental Facilities

Refer also to abstracts 25678, 25686, 26489, and 27039.

26174 (CEA-R-4212) PREPARATION AND PROPERTIES OF METAL HYDRIDE TARGETS USED IN NEUTRON PRODUCTION. Detaint, Jacques (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Nov 1971. 140p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Grenoble Univ. (France). Faculte des Sciences.

Physicochemical phenomena associated with the bombardment of metals with hydrogen ions and the implantation of these ions into their hydrides were studied (sputtering, spatial distribution of stopped deuterons, hydrogen diffusion, gas bubble formation, etc.). The time dependence of the neutron yield was studied with self-loading targets and prehydrogenated targets; a simple theory concerning the half-lives of tritiated targets was developed. A new type of target is proposed which has a longer lifetime: the diffusion barrier target. The method of manufacture is discussed, and a new apparatus constructed for its preparation is described. It includes an electron gun evaporator for depositing thin metallic films (Ti, Y, Zr, Er ...) under ultrahigh vacuum and a reaction furnace into which the films are placed under vacuum and in which their hydrides are formed. (France)

26175 (CERN 72-2) LOW-ENERGY SEPARATED BEAM FOR STOPPED K MESONS AND ANTIPROTONS. Bamberger, A.; Colombo, A.; Egger, J.; Lynen, U.; Petrucci, G.; Piekarz, H.; Povh, B.; Ritter, H. G.; Sepp, G.; Soergel, V. (European Organization for Nuclear Research, Geneva (Switzerland)). 20 Jan 1972. 9p. Dep. NTIS (U. S. Sales Only).

A low-energy separated beam was constructed at the external target in the slow extracted proton beam of the CERN Synchrotron. The beam is used for experiments with stopped K mesons and measurements of antiprotonic x rays. The separation of the particles is achieved by using their different energy losses in a degrader. Two versions, of different lengths, were built. Beam characteristics are given along with rates of stopping particles and production cross sections. (5 figures, 5 tables) (R.W.R.)

26176 (IFVE-OP-71-46) SHAPING OF POSITIVE BEAMS WITH MOMENTA 25 TO 70 GeV/c FROM THE INTERNAL TARGET OF THE IHEP ACCELERATOR. Golovnya, N. I.; Grachev, M. I.; Gubrienko, K. I.; Eremenko, E. V.; Zapol'skii, V. N.; Kotov, V. I.; Prokoshkin, Yu. D.; Seleznev, V. S.; Khodyrev, Yu. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

Ejection of positive secondary beam (protons, positive pions and kaons, and deuterons) from the internal target of the IHEP proton synchrotron is described. The optical scheme of the beam and the main parameters of positive beams formed with the momentum up to 70 GeV/c are presented. (auth)

26177 (LA-4842) LAMPF NEUTRINO FACILITY PROPOSAL. Lande, K.; Reines, F. (Los Alamos Scientific Lab., N. Mex.). Dec 1971. Contract W-7405-eng-36. 46p. Dep. NTIS.

The LAMPF neutrino facility and various problems that can be studied through its use are briefly described. Five formal proposals for various neutrino experiments are included in the appendix. (R.W.R.)

26178 CALCULATION METHOD FOR DESIGNING ACCELERATOR TARGET COOLING SYSTEMS. Kas, J. (Kossuth Univ., Debrecen, Hungary); Novak, D. Nucl. Instrum. Methods; 99: No. 2, 359-63(1972).

A method for the calculation of the necessary water circulation in accelerator-target cooling systems is described. The transferred heat is assumed to consist of two components. Part of the dissipated heat is carried away directly from the ion-beam spot while the other part from a surrounding annular surface. Expressions are given for the calculation of each component. The relative weight of each component in the total heat transfer is evaluated at different spot diameters. A model experiment was performed to check the validity of the calculation method. (5 figures) (auth)

26179 TECHNIQUES FOR THE PREPARATION OF THICK AND THIN ARSENIC TARGETS SUITABLE FOR CYCLOTRON IRRADIATION. Nunn, A. D. (Hammersmith Hospital, London). Nucl. Instrum. Methods; 99: No. 2, 251-4(1972).

An apparatus is described for the preparation of arsenic metal targets 130 mg cm^{-2} thick by the sublimation of arsenic metal. The targets are used for the cyclotron production of ^{77}Br. An apparatus for the production of arsenic metal targets 400 μg cm^{-2} thick by the decomposition of arsine is also described. The targets are being used for excitation function measurements. (2 figures) (auth)

26180 NEUTRON TIME-OF-FLIGHT FACILITY AT RICE UNIVERSITY. Rendic, D.; Mutchler, G. S.; Emerson, S. T.; (and others) (Rice Univ., Houston, Tex.). Nucl. Instrum. Methods; 99: No. 2, 189-203(1972).

A neutron time-of-flight (T-o-F) facility in the T. W. Bonner Nuclear Laboratories at Rice University, developed in connection with the EN tandem Van de Graaff accelerator, is presented. The details of the pulse shape discrimination and neutron detection as well as the beam pulsing and bunching are described. Characteristic neutron detector efficiency data and neutron T-o-F spectra are shown. (19 figures, 1 table) (auth)

26181 PREPARATION OF THIN TARGETS ON THIN GRAPHITE BACKINGS BY MOLECULAR PLATING. Sedlacek, W. A. (Los Alamos Scientific Lab., N. Mex.). Nucl. Instrum. Methods; 99: No. 3, 429-31(1972).

A technique for preparing thin targets on thin carbon backing based on the method of molecular plating is utilized to prepare targets suitable for nuclear reaction spectroscopy. (3 figures, 1 table) (auth)

26182 BEAM TRANSPORT SYSTEM AT THE HAMBURG ISOCHRONOUS CYCLOTRON. Abels, C.; Pegel, C.; Schirm, N.; Scobel, W.; Trautsch, W. (Univ., Hamburg). Nucl. Instrum. Methods; 99: No. 3, 557-61(1972). (In German).

Based on the experience with the beam handling of the undeflected external beam of the Hamburg Isochronous Cyclotron, HAIZY, a beam transport system was developed. The concept of this system and its realization are discussed from the physical and technical points of view. (3 figures) (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 26251, 26367, 26458, 26498, 26499, and 26714.

26183 (N-72-12810) INTERACTION OF COSMIC RAYS WITH INTERSTELLAR MATTER AND POSSIBLE EXCITATION OF X-RAY LINES. Verma, Satya Dev (Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy). [1971]. 5p. (NASA-CR-124580; OG-9). NTIS.

It is proposed that the excess diffuse cosmic x rays in the fractional-keV energy band are produced as a result of excitation of neutral carbon, sulfur, and argon atoms by cosmic rays, with subsequent emission of the K x rays of carbon and the L x rays of sulfur and argon. It is suggested that, if the intensities of low-energy cosmic rays and the cross sections for the production of x-ray lines were known, the observations of x-ray lines could provide direct information concerning abundances of elements in the interstellar regions. (auth) (STAR)

26184 (N-72-12811) EXPERIMENT TO STUDY THE NUCLEAR COMPONENT OF PRIMARY COSMIC RAYS. Paul, J. M.; Verma, S. D. (Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy). [1971]. 6p. (NASA-CR-124578). NTIS.

An apparatus was designed to study the charge composition, fluxes, and energy spectra of light nuclei in the energy region from 1 to 100 GeV. The apparatus essentially consists of an array of a large number of particle detectors operated in coincidence and serving as a charged-particle telescope. A mosaic silicon semiconductor detector, a plastic scintillation counter, and a lucite Cherenkov detector are used to measure the charges of the incident nuclei. Two one-inch-thick CsI detectors are used to study low-energy particles. An ionization spectrometer is utilized to measure primary energies in the 1- to 100-GeV energy interval. A gas Cherenkov counter is being designed to distinguish between electrons and protons. It is planned to calibrate the apparatus at an accelerator using particles of known energy. (auth) (STAR)

26185 (NP-19243) SOLAR MODULATION OF GALACTIC PARTICLES, NUMERICAL INTEGRATION OF THE STEADY FOKKER-PLANCK EQUATION. Martinic, Nicolas J. (Uppsala Univ. (Sweden)). 1972. 50p. Dep. NTIS (U. S. Sales Only).

Thesis.

Galactic particles, in this case protons and electrons, are modulated by the solar atmosphere showing, as a general feature, a decrease in the flux in $-\nu$, the outside of the interplanetary space. From the numerical integration of the steady, spherically symmetric Fokker-Planck equation, which governs this phenomenon as a first approximation, it is shown that the galactic flux measured at the Earth presents the effect of: (a) convection, i.e., the sweeping-out of the galactic particles at the convective outward velocity of the solar wind (~400 km/sec at steady conditions), creating a gradient of these particles; and (b) diffusion, i.e., the dynamical equilibrium between the gradient of galactic particles and the flux of particles, which tends to neutralize this gradient. The diffusion mechanism is defined by the diffusion coefficient, taken as scalar and linearly dependent with respect to the particle's velocity and rigidity, together with the functional radial dependence: $\exp(r/r_0)$, where r is the radial variable and r_0 defines the modulation region ~1 AU. Finally (c) the adiabatic deceleration, i.e., the "cooling-down" effect of expansion of the bulk of galactic particles tied to the magnetic inhomogeneities frozen-in the solar plasma. The density of galactic particles is given for a wide interval of energies (10^3 to 10^{-3} BeV) for all values of the radial distance in interplanetary space, whose range is 10 and/or 25 AU and for rigidity, kinetic energy, and total energy power laws, for protons; and the Webber law (galactic flux proportional to $T^{-\epsilon}$, $\epsilon = \gamma - 1.2/(T + 1.6)$, $\gamma = 2.5$, where T is given in BeV) for electrons in the same range of energies. (auth) (Sweden)

26186 HIGH-ENERGY ASTROPHYSICS RESEARCH AT THE MAX-PLANCK INSTITUT. Pinkau, K. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). Atomkernenergie; 19: No. 2, 133-8(Apr 1972).

Experimental research in high-energy astrophysics as carried out at the Max-Planck-Institut für Extraterrestrische Physik in Garching is described. Some results are presented and future plans outlined. (auth)

26187 MEASUREMENTS OF THE RELATIVE ABUNDANCES OF EXTREMELY HEAVY COSMIC RAYS. Wefel, John Paul. St. Louis; Washington Univ. (1971). 286p. University Microfilms Order No. 72-9371.

Thesis.

Plastic track detectors and nuclear emulsions were exposed to the high-energy primary cosmic radiation on five high-altitude balloon flights. The combined exposure was 1.4×10^7 m^2-ster-sec. Each package incorporated an altitude-shift mechanism to decide which of the cosmic-ray tracks, found by automatic spark scanning of plastic detectors, were formed while the detector package was above 100,000 feet. A total of 546 altitude cosmic-ray tracks were followed through layers of Cellulose tri-acetate, cellulose acetate butyrate and Lexan plastic. After etching in a controlled temperature sodium hydroxide solution, the track etching rate V_t was measured for each plastic. Two additional balloon flights recorded tracks of low-energy cosmic rays that stopped in the detector. (TSS) (Diss. Abstr. Int., B)

26188 MEASUREMENT OF ^{53}Mn AND ^{54}Mn PROFILES IN LUNAR ROCKS AND METEORITES. Fruchter, Jonathan Sewell. San Diego, Calif.; Univ. of California (1971). 177p. University Microfilms Order No. 72-6523.

Thesis.

Improved techniques for the detection of ^{53}Mn ($t_{\frac{1}{2}} = 3.7 \times 10^6$ yrs) and ^{54}Mn ($t_{\frac{1}{2}} = 303$ days) are reported. Measurements of a depth profile of ^{54}Mn in lunar rock 12002 are reported, as are measurements of ^{53}Mn depth profiles in lunar rocks 10017 and 12002, and in the Rosebud meteorite. From the depth profiles of ^{53}Mn, average fluxes of solar-flare particles over a period of 5×10^6 years are calculated by the use of models. The flux calculated from the ^{54}Mn profile is compared with satellite data collected over the same period. The agreement between the two is considered fair. A comparison between the ^{53}Mn and ^{54}Mn profiles shows that the flux of solar protons over the last 5 million years has been very similar to that of the present solar cycle, although perhaps somewhat lower. An erosion rate of 0.6 mm/10^6 yrs is calculated for lunar rock 12002 assuming that the flux and rigidity of solar protons over the mean life of ^{53}Mn was the same as that indicated by the profile of ^{26}Al ($t_{\frac{1}{2}} = 7 \times 10^5$ yrs). The first firm evidence of solar-flare effects in the surface of a meteorite is presented in the ^{53}Mn profile measured in a core of the Rosebud chondrite. This profile indicates that 1 cm or less was ablated from the back surface of Rosebud and that it was bombarded by a similar but perhaps somewhat lower flux of solar protons than were the lunar rocks. (Diss. Abstr. Int., B)

26189 COMPTON SCATTERING OF PLASMA AND MAGNETOHYDRODYNAMIC WAVES ON RELATIVISTIC ELECTRONS AS A SOURCE OF RADIATION FROM SOME METAGALACTIC OBJECTS. Getmantsev, G. G. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 14: No. 5, 659-62(1971). (In Russian).

From the energetic point of view the scattering of relativistic electrons with power law energy distribution on the low-frequency waves in a space plasma is shown to be more effective at sufficiently large index γ than the synchrotron radiation mechanism. The Compton scattering of plasma and other low-frequency waves on relativistic electrons is most probably the source of decameter radiation of many metagalactic objects having a sufficiently steep frequency spectrum. (auth)

26190 URANIUM COSMOCHRONOLOGY. Sobotovich, E. V. Meteoritika; No. 28, 30-43(1968). (In Russian).

The Burbidge theory of nuclear synthesis proposes that, beginning with Fe, all heavier elements are derived by thermal-neutron capture. The uranium/lead contents of iron, rock, and other types of meteorites have yielded information on the age of the systems and the times of their differentiation. The age of terrestrial uranium has been derived from the ^{235}U/^{238}U ratio as 30 b.y. and from the ^{232}Th/^{238}U ratio as 4.4 b.y., and this discrepancy is discussed in some detail. The pre-solar origin of certain iron meteorites and their ^{207}Pb/^{206}Pb ratios point to an age between 3800 and 2500 m.y. (25 references) (K.S.W.)

26191 COMPOSITION OF RELATIVISTIC VH AND VVH COSMIC RAYS. Mewaldt, Richard Alvin. St. Louis; Washington Univ. (1971). 283p. University Microfilms Order No. 72-9358.

Thesis.

A large-area detector system (.92 m^2·ster) employing parallel-plate pulse ionization chambers and a total-internal-reflection Lucite Cerenkov counter was constructed, tested, and successfully flown on three high-altitude balloon flights during 1970. A

total of 28 hours of float data were recorded at an average atmospheric depth of 4.6 g/cm², and an average geomagnetic cutoff of 4.5 GV. More than 50,000 particles with charge $Z \geq 14$ were recorded, including some 25,000 VH nuclei ($20 \leq Z \leq 30$), several times the total of all previous investigations. Charge resolution was ±.75 charge units at iron (Z = 26). An analysis of the performance of the ionization chambers and Čerenkov counter is presented. From direct measurements of the attenuation of VH nuclei in the atmosphere, attenuation mean free paths are derived for VH nuclei ($\Lambda_{VH} = 19.7 + 1.8$ g/cm²) and iron nuclei ($\Lambda_{Fe} = 15.6 + 2.2$ g/cm²). Measurements of the absolute flux of various charge groups for $16 \leq Z \leq 30$ are extrapolated to the top of the atmosphere. The flux of VH nuclei is found to be $J_{VH} = .46 \pm .02$ particles/m²·sec·ster at a geomagnetic cutoff of 4.5 GV and a Mt. Washington neutron monitor rate of 2087. The relative flux of even-Z nuclei with $16 \leq Z \leq 26$ is determined and extrapolated to the top of the atmosphere. Results include a calcium-to-iron ratio of Ca/Fe = .21 ± .04, and a lower chromium abundance (Cr/Fe = .15 ± .03) than has been found by most other workers. These abundances are compared with cosmic-ray propagation calculations assuming various possible source compositions. Thirteen VVH ($Z \geq 31$) nuclei were observed, the largest of which had $Z \approx 44$. The flux of VVH nuclei is found to be $2.6 \pm .8 \times 10^{-4}$ particles/m²·sec·ster. The charge distribution of these nuclei is compared with propagation calculations for cosmic-ray sources based on models of nucleosynthesis. (TSS) (Diss. Abstr. Int., B)

26192 BALLOON MEASUREMENTS OF THE ENERGY SPECTRUM OF COSMIC ELECTRONS BETWEEN 1 AND 25 GeV. Earl, James A.; Neely, Dennis E.; Rygg, Thomas A. (Univ. of Maryland, College Park). J. Geophys. Res.; 77: No. 7, 1087-1102(1 Mar 1972).

During three balloon flights made in 1966 and 1967, cosmic electrons were investigated with the aid of a hodoscope detector that provided extensive and detailed information on each cosmic-ray event triggering the apparatus. Similar information obtained during calibration exposures to protons and pions as well as to electrons was used to provide identification of cosmic electrons and to determine their energies. Differential primary electron intensities measured in the range from 1 to 25 GeV were substantially larger than some earlier measurements. In conjunction with existing measurements at energies above 100 GeV, this finding indicates that the energy spectrum of cosmic electrons is steeper than that of cosmic-ray nuclei and consequently suggests that Compton/synchrotron energy loss plays a significant role in shaping the electron spectrum. (auth)

26193 COMMENT ON PAPER BY D. B. SWINSON, SOLAR MODULATION ORIGIN OF SIDEREAL COSMIC-RAY ANISOTROPIES. Elliot, H.; Thambyahpillai, T.; Otaola, J. A. (Imperial Coll. of Science and Tech., London). J. Geophys. Res.; 77: No. 7, 1342-6(1 Mar 1972).

An analysis was made of the mechanism proposed by Swinson (J. Geophys. Res., 74: 559(1969) and 76: 4217(1971)) for generating a spurious sidereal daily variation in the cosmic-ray intensity and his suggestion that previous experimentally observed sidereal variations are due to this process. After a discussion of all the parameters of Swinson's work and other related experiments, it is concluded that, to the present limits of accuracy, there is no reason to believe that any significant spurious sidereal variation of the kind envisaged by Swinson is present in the data at 60 mwe, although its presence at smaller depths and at ground level is not excluded. It seems that the explanation of the observed variation at 60 mwe in London in terms of solar motion is the more likely one. In addition to offering an alternative, Swinson (1971) objected to this explanation on the grounds that it cannot account for observations in the southern hemisphere, but, to date, there has been no protracted series of observations at 60 mwe in that hemisphere. Whichever explanation is correct, the main conclusion reached by Elliot et al. (1970) that there is no sidereal anisotropy in excess of 0.02% remains unchanged. A reply by Swinson follows and after discussing the facts known and unknown, it is concluded that the amplitudes of the sidereal diurnal variation at London of 0.015 ± 0.005% and at Socorro of 0.012 ± 0.010% for 1968–1970 are consistent with an upper limit of 0.02% to the sidereal anisotropy; whether this is an upper limit to a galactic anisotropy, a local anisotropy perpendicular to the ecliptic plane, or a combination of both remains to be determined. (J.C.W.)

26194 ANTIPROTON SPECTRUM IN COSMIC RAYS. Chen, M. C. (Univ. of Nevada, Las Vegas). Nuovo Cim.; 8B: No. 2, 343-57(11 Apr 1972).

The steady-state antiproton spectrum in cosmic rays as a result of the collision between primary cosmic protons and interstellar hydrogen was calculated by means of the statistical model of two fireballs in multiple-particle production. Results based on Fermi's original one-fireball model are also presented for comparison. It was found that the antiprotons obey approximately a power law with an exponent about 2.6 which is about (the same magnitude) equal to the exponent of the general cosmic-ray spectrum. The numerical value of the exponent was found to be determined principally by the exponent of the cosmic protons, and very insensitive to the parameters of the two-fireball model introduced in the calculation. A closed expression of the ratio of the number densities of these secondary antiprotons to cosmic protons is expressed in terms of the proton exponent, interstellar hydrogen density, total p–p inelastic cross-section, antiproton lifetime in the Galaxy and the two-fireball parameters. The numerical values of the ratio range from about 3.8×10^{-3} at 10^{12} eV to 6.8×10^{-4} at 10^{15} eV. (auth)

Stars

Refer also to abstracts 26591, 26789, and 27107.

26195 (AD–733333) IR STARS: SEARCH FOR 3.5-MM RADIATION AND TENTATIVE DETECTION OF VY CMA. Report for October–November 1970. Wilson, W. J. (Aerospace Corp., El Segundo, Calif.). 15 Aug 1971. Contract F04701-71-C-0172. 15p. (SAMSO-TR-71-262). NTIS.

A search was made for 3.5-mm radiation from twelve IR stars with strong 10-micron radiation. The sources VY CMa and IRC + 10216 were tentatively detected with 3.5-mm fluxes of 0.2 ± 0.07 (sigma) f.u. and 0.4 ± 0.2 f.u., respectively. The IRC + 10216 result was consistent with a measurement by Kellermann and Pauliny–Toth. If the 3.5-mm radiation comes from an optically thick circumstellar region having the IR temperature of 600°K, this region would have a linear dimension of about 100 A.U. (auth) (NTIS)

26196 (AD–733424) ASTROPHYSICAL OBSERVATIONS OF POLARIZED STARS AND NEBULAE. Final Report, April 1, 1968–June 30, 1971. Liller, William (Harvard Coll. Observatory, Cambridge, Mass.). Aug 1971. Contract F19628-68-C-0228. 11p. (AFCRL-71-452). NTIS.

In the last 39 months, numerous measurements of the degree of optical polarization of the light emitted by a wide variety of astronomical sources have been made. These data have led to a better understanding of the surface properties of asteroids and satellites, of the nature of the interstellar grains, and of the characteristics of planetary nebulae, quasars, and pulsars. The results have been extended by observations of other types, primarily spectrographic. (auth) (NTIS)

26197 CONTACT BINARY SYSTEMS: WHY THE SECONDARY MIGHT BE HOTTER. Whelan, J. A. J. (Univ. of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 156: No. 1, 115-28 (1972).

Some aspects of the contact binary problem are discussed. The case of energy transfer occurring in the superadiabatic part of the convective envelope is considered and compared with the methods of Lucy (Astrophys. J., 151: 1123(1968) and 153: 877 (1968)) and Moss and Whelan (Mon. Notic. Roy. Astron. Soc., 149: 147(1970)). New results for ZAMS nonrotating model contact systems, which illustrate the effects of changes in several parameters, are presented. The importance, for the construction of systems with unequal components, of the depth of the convective envelope at the pp-chain, CN-cycle switchover mass is demonstrated. The results show good, but not sufficient, agreement with observations for W UMa systems. The "superadiabatic" energy-transfer mechanism naturally accounts for the secondary being the hotter component. (auth)

26198 OBSERVATIONS OF THREE SHORT PERIOD RR LYRAE VARIABLES. Penston, Margaret J. (Royal Greenwich Observatory, Herstmonceux, Eng.). Mon. Notic. Roy. Astron. Soc ; 156: No. 1, 103-13(1972).

Observations of the RR Lyrae variables AE Boo, TV Lyn, and RW Ari are presented. For all three variables light curves in the UBV system are given. A period is derived for AE Boo for which no ephemeris was previously available, and measures of the radial velocity of this variable are also given. (auth)

26199 IONIZATION STRUCTURE OF PLANETARY NEBULAE. IX. LUMINOUS FILAMENTS. Van Blerkom, David; Arny, Thomas T. (Univ. of Massachusetts, Amherst). Mon. Notic. Roy. Astron. Soc.; 156: No. 1, 91-101(1972).

Recent observational and theoretical evidence indicates that density condensations optically thick to ionizing radiation exist in planetary nebulae. Such a condensation shields the gas in a column behind it from the stellar radiation field so that the

shielded gas is ionized only by the diffuse radiation from the neighboring gas. Since stellar radiation is characterized by an effective temperature that may exceed 10^5°K and diffuse radiation is emitted by a gas that does not differ significantly from 10^4°K, the physical conditions in the shadowed and unshadowed regions are quite different. Although the shadow-free gas can be very highly ionized, the shadow zone is composed predominantly of singly ionized atoms. Viewed in the light of lines from singly ionized atoms, the shadow appears as a luminous filament. The comet-like structures seen in NGC 7293 are suggested to be optically thick condensations ("heads") and the associated luminous shadows ("tails"). (auth)

26200 MODEL FOR THE TOTALLY ECLIPSING W URSAE AJORIS SYSTEM AW UMa. Mochnacki, S. W.; Doughty, N. A. (Univ. of Canterbury, Christchurch, New Zealand). Mon. Notic. Roy. Astron. Soc.; 156: No. 1, 51-65(1972).

A method for the synthesis of theoretical light curves and line profiles for close binary systems is outlined, considering Roche geometry, nonlinear limb darkening and convective envelopes with irradiation and gravity darkening. A scaled blackbody approximation is used for calculating fluxes. Theoretical internal eclipse contact angles were computed for common envelope configurations, providing an approximate constraint upon the solution of observed light curves. The method is applied to the totally eclipsing system AW UMa, for which the unusually low mass ratio of 0.079 is obtained. (auth)

26201 OBSERVATIONS OF RAPID BLUE VARIABLES. III. HL TAU-76. Warner, Brian; Nather, R. Edward (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc.; 156: No. 1, 1-5(1972).

New high-speed photometric observations of the white dwarf HL Tau-76 are reported which strongly suggest that the variability of this star is caused by an underlying driving mechanism with a period of 12.437 ± 0.003 min. The light curve is, however, complicated by phase jitter about this basic period. Three-color photometry of the outbursts in HL Tau-76 shows that there is an increase in temperature of ~650°K during outburst. This is sufficient to explain the observed increase in brightness, and suggests that no significant change in radius is taking place. (auth)

26202 FAR INFRARED OBSERVATIONS OF M42, NGC 2024 AND M1. Furniss, I.; Jennings, R. E.; Moorwood, A. F. M. (University Coll., London). Nature (London) Phys. Sci.; 236: No. 62, 6-7(6 Mar 1972).

Measurements of the far-infrared fluxes from two known sources, in M42 (Orion Nebula) and NGC 2024, respectively, as well as an upper limit for the far-infrared flux from M1 (Crab Nebula), made at balloon altitudes of 30 km from Palestine, Texas, during September 1971, are described. The measurements were made with a Ga-doped Ge bolometer cooled into liquid He operating on the UCL balloon-born telescope. Wavelength response of the system was from 40 to 350 μm. Details are given of the experimental technique, and results are tabulated and discussed. (UK)

26203 ANALYSIS OF THE LIGHT CURVES OF TEN ECLIPSING BINARY SYSTEMS. Proctor, Deanne Dorothy. East Lansing, Mich.; Michigan State Univ. (1971). 173p. University Microfilms Order No. 72-8760.

Thesis.

Computer programs for the Fourier analysis, rectification, and solution of eclipsing binary light curves were written. Both Kopal's method and the method of differential corrections were generalized to include third light. The method of differential corrections was further generalized to include orbital eccentricity directly. Synthetic light curves were used to validate the computer programs, as well as to determine the effect of dispersion and number of observations on the ability to extract the desired parameters. Analysis of synthetic data indicated limb-darkening coefficients may be extracted from observations of sufficient accuracy and density. This conclusion was found to hold for partial as well as completely eclipsing systems. In addition, it was found possible to extract values of third light. The data from 10 eclipsing binary systems were rectified and subsequently analyzed using differential corrections. The systems were CO Lacertae, CM Lacertae, RX Arietis, V338 Herculis, Y Leonis, RW Monocerotis, BR Cygni, BV 430, BV 412, and SW Lyncis. (TSS) (Diss. Abstr. Int., B)

26204 CARBON AND OXYGEN PRODUCTION DURING THE HELIUM BURNING PHASE IN INTERMEDIATE MASS STARS. Turner, Lawrence Edward Jr. East Lansing, Mich.; Michigan State Univ. (1971). 194p. University Microfilms Order No. 72-8795.

Thesis.

Stars of 5.0, 7.0, and 15.0 $M_\odot$ were evolved from a homogeneous initial composition of extreme population I until core-helium burnout. Helium-burning reactions through neon–alpha were considered. The carbon–alpha reaction rate was obtained from an R-matrix model of the 1^- states in ^{16}O. The equation of state included ionization and degeneracy. Neutrino cooling was computed in hydrogen-free regions. The evolution of the 7.0 $M_\odot$ star was repeated with a different value of the carbon–alpha reaction rate. This was used to test the feasibility of evolving only the core of the star to investigate further the effects of the reaction rates on the end abundances. The evolutions of the core agreed quite well with the evolutionary sequences of the entire star. The core took about $1/12$ the computer time that was needed for the entire star. The uncertainties in the triple-alpha rate led to an uncertainty in the final abundance of carbon of about 20%. A large range of the carbon–alpha reaction rate was considered. The reduced level width of the 7.12-MeV state was varied from 0.005 to 0.10 MeV. The effect was to change the final carbon abundance from about 0.66 to 0.03. The effect of the different conditions due to the mass of the star was quite small. A large uncertainty arose from the growing convective core. This was due to the exact method by which convection was handled. No semi-convection was considered. The maximum effect was estimated to reduce the final carbon abundance by about 20%. The conditions of helium burning were such as to produce a constant density and a constant energy-generation-rate situation. This was a better approximation than constant density and temperature. The fixed conditions that best reproduce the end abundances were those that occurred when the energy-generation rates due to the triple-alpha and the carbon–alpha reactions were equal. (Diss. Abstr. Int., B)

26205 EVOLUTION OF DIFFERENTIALLY ROTATING WHITE DWARF STARS. Africk, Steven Allen. Providence; Brown Univ. (1971). 119p. University Microfilms Order No. 72-8078.

Thesis.

The consequences of a mechanism that redistributes angular momentum in differentially rotating white dwarfs are investigated. The properties of zero temperature models — including the existence of the Chandrasekhar mass limit of 1.44 solar masses — are discussed, and the refinements due to consideration of realistic equations of state are enumerated. In this connection, the possibility of the formation of a crystal lattice at finite temperatures is noted. It is asserted that due to nuclear and general relativistic effects, white dwarfs of mass slightly below the mass limit can be dynamically unstable due to their high central densities. Stability arguments against the existence of hydrogen white dwarfs are presented, and the picture of the white dwarf as an endpoint of stellar evolution is drawn. The obvious difficulty — that this stellar state is unavailable to stars more massive than the mass limit — is discussed. The inclusion of centrifugal forces is considered, and the slight relaxation of the mass limit for stars in rigid rotation is described. Differentially rotating white dwarfs are singled out as the only known equilibrium configurations of degenerate matter with no mass limit. The effect of cooling and lattice formation (freezing) in the interior of a differentially rotating white dwarf is considered. The self-consistent field method of constructing equilibrium models developed by Ostriker and Mark is outlined. Also, an iterative scheme by which the function describing the angular momentum per unit mass can be evolved to produce sequences of models representing evolution due to the freezing process is presented. Such sequences obtained for four stars with initial central densities above 10^8 g/cm^3 and more mass and angular momentum than is compatible with rigid rotation are described. (TSS) (Diss. Abstr. Int., B)

26206 SPECTROSCOPIC STUDY OF THE OB ASSOCIATION III CEPHEUS. Garmany, Catharine D. Charlottesville, Va.; Univ. of Virginia (1971). 86p. University Microfilms Order No. 72-7186.

Thesis.

A spectroscopic and astrometric study of the OB association III Cepheus, one of the youngest within one kiloparsec of the Sun, was carried out, and the results are compared with those associations studied by Blaauw, Van Albada and others. (TSS) (Diss. Abstr. Int., B)

26207 NUMERICAL ANALYSIS OF THE VARIATIONS IN THE LIGHT CURVES OF THE CLOSE BINARY SYSTEMS, W URSAE MAJORIS AND U PEGASI. Rigterink, Paul Vernon. Philaelphia; Univ. of Pennsylvania (1971). 173p. University Microfilms Order No. 72-6218.

Thesis.

Photoelectric observations of yellow and blue magnitudes of W Ursae Majoris and U Pegasi are presented. The light curves are compared with previous observations, and the changes in the light curves are noted. It is found that both light curves can be separated into a mean binary light curve which can be explained using standard theories and a disturbing light curve which is only partially understood. New orbital elements are derived for both systems using the mean binary light curve. In addition, an analysis is made of the validity of the present and previous solutions. (Diss. Abstr. Int., B)

26208 ELEMENT ABUNDANCES IN A AND F STARS HR 5447, HR 6290, HR 6596, HR 6917, AND HR 7061. Avery, Rexford Warner. Philadelphia; Univ. of Pennsylvania (1971). 136p. University Microfilms Order No. 72-6130.

Thesis.

Fine analyses of HR 5447, HR 6290, HR 6596, HR 6917, and HR 7061 are presented. Model atmospheres for the above stars plus HR 5986 are also given. HR 5447 is a definite metal-poor (weak-line) star. HR 7061 is slightly underabundant in metals. HR 6290 and HR 6596 have solar-type abundances. The metals in HR 6917 are slightly overabundant. An extensive discussion and analysis of the oscillator strengths of the iron-peak elements is also presented. (Diss. Abstr. Int., B)

26209 MOTIONS AND ABSOLUTE MAGNITUDES OF RR LYRAE STARS. Hemenway, Mary Kathleen Meacham. Charlottesville, Va.; Univ. of Virginia (1971). 89p. University Microfilms Order No. 72-7187.

Thesis.

New proper motions of 65 RR Lyrae field stars were derived using McCormick plate pairs with an average time base of 39 years. Solar motion solutions were made using published radial velocities. Using all stars for which accurate photoelectric photometry, radial velocities, and proper motions are known, statistical parallaxes were calculated. The A-type stars were grouped by period and by metal type, with the C-type stars treated independently. For the total A-star group the resultant mean light visual absolute magnitude was 0.49 mag, which corresponded to M_B of 0.63 mag. Parameters of galactic orbits obtained from space velocities showed a relation to period. (Diss. Abstr. Int., B)

26210 THREE-COLOR PHOTOMETRY OF NGC 7245 AND NGC 7226. Karaali, Salih (Istanbul Univ. Observatory). Istanbul Univ. Fen Fak. Mecm., Seri C; 34: No. 1-4, 149-52(Jan-Oct 1969).

Three-color photometry of the clusters NGC 7245 and NGC 7226 were studied in the UBV system, and their distances determined with the "fitting method" are compared with those found in the RGU system. (auth)

26211 METHODS TO CALCULATE THE IMPROVED TEMPERATURE DISTRIBUTION IN NONGRAY STELLAR ATMOSPHERES. Sapar, A.; Kruusmaa, A. Publ. Tartu. Astrofiz. Observ.; 38: 3-28(1970). (In Russian).

The methods of Λ^2 and Λ^1 iteration treated by Tsuji are considered. Taking into account the variation of the absorption coefficient with temperature, an improved equation for the iteration process and for its first step are obtained. The method for calculating the exact temperature distribution elaborated by Avrett and Krook [1963] is considered. All the methods mentioned do not converge uniformly for the case of prevailing scattering. The iterative formulae converge uniformly for the case of prevailing scattering. The very elegant method introduced by Henyey is presented. The methods considered by Avrett and Krook [1963] and by Sapar and Viik [1968] in which the temperature distribution and the pressure distribution are corrected simultaneously are considered, and the terms, taking into account the energy exchange with the matter in the scattering processes, are found. (auth)

26212 RADIATIVE TRANSFER IN A MOVING SPHERICAL ATMOSPHERE OF A STAR. Viik, T. Publ. Tartu. Astrofiz. Observ.; 38: 46-56(1970). (In Russian).

The problem of the radiative transfer in a spherical atmosphere undergoing differential expansion is considered. The opacity in the atmosphere is assumed to be due to scattering on free electrons. It is assumed that the velocity of the material is a linear function of the optical depth. The equation of radiative transfer is derived following Chandrasekhar (1945). The integral that appears in the transfer equation is replaced by a sum according to Radau's formula for numerical quadratures and the derivative of the intensity with respect to μ is eliminated according to Chandrasekhar (1953). Using the Fourier transform the transfer equation can be written in a form that is formally identical to that found by Edmonds (1950) in the plane-parallel case. Edmonds' techniques for solving the system and for obtaining the formula of emergent radiation are followed. (auth)

26213 MECHANISM OF THE REFLECTION EFFECT. Pustyl'nik, I. B. Publ. Tartu. Astrofiz. Observ.; 38: 57-67 (1970). (In Russian).

The effectiveness of Rayleigh scattering on H atoms and of pure absorption by H^- ions was evaluated for the case when the G–K subgiant component of a close binary re-emits the radiation falling on it from the B5–A0 primary star. Lyman-α photons of the primary component are responsible for the high electron pressure in re-emitting layers through the ionization of neutral hydrogen. It appears therefore that the absorption by H^- ions is much more effective than Rayleigh scattering. It is noted that convection may influence the bolometric reflection amplitude. (auth)

26214 ABSORPTION COEFFICIENT OF QUASI-MOLECULAR HYDROGEN. Kuuzik, I. Publ. Tartu. Astrofiz. Observ.; 38: 68-78(1970). (In Russian).

The absorption coefficient of quasi-molecular hydrogen in stellar atmospheres for the conditions of thermodynamic equilibrium is calculated. In treatment of the transition probability, the moments from the Edgeworth expansion of the distribution function are used. The results are two or three times smaller than those by Solomon (1964). Comparing the results obtained with the absorption coefficient for atmospheres by Bode (1965) shows that the absorption of quasi-molecular hydrogen is important in dwarfs of spectral classes A–G with log g ~ 10 and in the spectral region near 2000 Å. In atmospheres of main-sequence B and G stars the quasi-molecular absorption is unimportant. (auth)

26215 DETERMINATION OF EFFECTIVE TEMPERATURES OF STARS BY SIX-COLOR PHOTOMETRY. Malyuto, V. D. Publ. Tartu. Astrofiz. Observ.; 38: 79-97(1970). (In Russian).

The problem of influence of spectral lines on the GRI magnitudes of Stebbins and Whitford six-color photometry is considered. The theoretical relation between line-free color indices (G–R) and (R–I) found from Swihart and Fischel model atmospheres is compared with the observational one. The corrections for blanketing effect on the GRI measurements for some stars are computed. It is found that the corrected positions of these stars on two-color diagrams are somewhat closer to the theoretical relation. It is concluded that the differences between theory and observations for other stars can be explained in terms of line blanketing. The influence of Fraunhofer lines is also shown. For determination of effective temperatures of stars with differing metal abundances it is proposed to use, parallel with the Stebbins and Whitford (G–I), the Johnson (V–I) color index because, as it is shown, this quantity is also insensitive to the intensity of spectral lines, at least in F2–G5 dwarfs. To overcome the discrepancy between the values $\Delta\Theta_{eff} = \Theta^{\star}_{eff} - \Theta^{\odot}_{eff}$, determined from (G–I) and (V–I), it is suggested to use the value $(V-I)_{\odot} = 0.83$m instead of the value 0.78m obtained by Johnson. (22 references) (auth)

26216 SOME REMARKS ON THE BINARY STAR μ Sgr. Luud, L.; Il'mas, M. Publ. Tartu. Astrofiz. Observ.; 38: 107-14(1970). (In Russian).

The nature of the binary star μ Sgr is discussed, using three spectrograms with dispersion 36 Å/mm and published data. It is shown that the primary is probably a P Cygni-type star and the mass loss from it is not caused by the secondary, which is likely also a hot star. The system needs further investigations using ultraviolet and infrared spectral and photoelectric observations. (auth)

26217 ATMOSPHERE OF THE PECULIAR A3 STAR 111 HER. Luud, L. S.; Kuusk, T. E. Publ. Tartu. Astrofiz. Observ.; 38: 115-22(1970). (In Russian).

The spectra of 111 Her was studied at 3700 to 4500 Å from nine plates with a dispersion of ~15 Å/mm. The microturbulence velocity was determined to be 12 km/s. The effective temperature is discussed, and a mean value $T_e = 8500°$ was obtained. Finally, the chemical composition was obtained by the model atmospheres of Hunger. Abundances for magnesium and manganese were found to be greater than in the atmospheres of normal stars. (tr-auth)

26218 SPECTROPHOTOMETRY OF F STARS. IV. Kipper, M. A.; Kipper, T. A. Publ. Tartu. Astrofiz. Observ.; 38: 123-43(1970). (In Russian).

Using high-dispersion spectrograms the equivalent widths of the lines in the spectrum of σ Boo (F2V) were measured and tabulated. Only the lines showing little blending effects were

measured directly for tracings with a planimeter. Equivalent widths of other lines were estimated by use of a relation between the central intensity and equivalent width. (auth)

26219 PHOTOELECTRIC INVESTIGATION OF THE CLOSE BINARY RZ CAS IN 1966–1967. Pustyl'nik, I.; Eerme, K. Publ. Tartu. Astrofiz. Observ.; 38: 144-71(1970). (In Russian).

In 1966–67 photoelectric observations of the close binary RZ Cas in B and V colors were carried out with the aid of a photometer attached to the 20″ Cassegrain reflector of Tartu Astrophysical Observatory. 616 and 608 single observations in B and V correspondingly were secured during 15 nights. The reduction of the light curve revealed that: 1) there was no flat bottom at the primary minimum during the observational period, as had been previously reported by Szafraniec; 2) a rather small but definitely negative reflection effect was present; and 3) the period of RZ Cas was 1.19525892d. The orbital elements of RZ Cas were determined by the Kopal–Tabachnik method for the Russell model as well as for atmospheric eclipse. Both patterns of the orbital elements were found to give good representation of the observed light curve. (auth)

26220 ATMOSPHERES OF THE F-TYPE SUPERGIANTS. I. CALIBRATION OF THE LUMINOSITY-SENSITIVE O I λ7774 LINE. Osmer, Patrick S. (Hale Observatories, Pasadena, Calif.). Astrophys. J., Suppl. Ser.; 24: No. 206, 247-53(Mar 1972).

The equivalent width of the O I λ7774 line was measured with a narrow-band photoelectric technique in 59 stars of spectral types A0–G3 and luminosity classes Ia–V. By calibrating the line strength in 10 F-type supergiants of known luminosities, it was found that it indicates their absolute magnitudes with an accuracy of 0.5 mag in the range $-4 > M_V > -9$, a significant improvement over previous methods. The calibration permits some of the most luminous stars known to be used as distance indicators. (auth)

26221 ATMOSPHERES OF THE F-TYPE SUPERGIANTS. II. THE LINE AND CONTINUOUS SPECTRA. Osmer, Patrick S. (Hale Observatories, Pasadena, Calif.). Astrophys. J., Suppl. Ser.; 24: No. 206, 255-82(Mar 1972).

Coudé spectra of 25 supergiants having spectral types from F2 to G5 and spectrophotometry of four F-type supergiants which are cluster members were used to determine their atmospheric characteristics. Curves of growth obtained from the spectra show that the microturbulence determined from the Fe II lines increases with luminosity and is correlated with the oxygen line strengths of Paper I. However, the Fe I microturbulence is insensitive to luminosity at spectral type F5. Both sets of lines have the same radial velocity in Ia and Ib supergiants of this type. Application of standard model-atmosphere techniques to the spectrophotometry produces reasonably effective temperatures, but the gravities of the class Ia supergiants are found to be a factor of 5 less than expected from stellar-interiors theory. The difference was less for the class Ib stars. Clearly, dynamical effects are important. Consideration of the effect of the turbulent motions on the pressure equilibrium indicates that the observed velocities are large enough to reduce the gas pressure and simulate a low gravity. The models also indicate that the observed microturbulence and a decrease in the continuous opacity account for the luminosity effect in the oxygen line. Although non-LTE effects may be present, they are not sensitive to luminosity. The gradient in radiation pressure beneath the photosphere exceeds the surface gravity in F-type supergiants with $\log g < 2$. The resulting instability is the probable cause of mass motions in supergiants. This hypothesis is supported by the observations that the instability first occurs at the gravity where the oxygen line becomes sensitive to luminosity and the observed turbulence begins to increase. Finally, it is shown that a turbulent velocity which increases with height in the atmosphere can account for the different behavior of the Fe I and Fe II lines at type F5 because the Fe I lines are formed at greater depths in the atmosphere. (auth)

26222 QUANTITATIVE ANALYSIS OF THE ATMOSPHERES OF TWO F STARS. Malyuto, V. D. Publ. Tartu. Astrofiz. Observ.; 39: 282-300(1971). (In Russian).

The curve-of-growth technique was used to find atmospheric parameters and abundances of some elements in the atmospheres of the δ Scuti-type star β Cas and the metal-rich star 10 UMa. The analysis was based on spectrograms with dispersion 15 Å/mm. It was found that the abundances of metals relative to iron are normal in both stars. For β Cas, $[Fe/H] \approx 0$, but the microturbulent velocity in the atmosphere is abnormally high. The last feature is also found in some other δ Scuti-type stars. (auth)

26223 PHOTOELECTRIC MINIMUM OF β PERSEI. Albo, Kh. Publ. Tartu. Astrofiz. Observ.; 39: 301-6(1970). (In Russian).

The results of the photoelectric observations of β Per in November 8 and December 21, 1964, are presented. The mean moment of the primary minimum obtained was: Min = J.D. hel 2 438 708.3449 ± 0.0007. There were evidences in favor of small variations in the depth of the minimum as suggested by Herczeg (1964). (auth)

26224 SPECTRUM OF P CYGNI IN 1968–1969. Luud, L.; Ibrus, U.; Kolka, I. Publ. Tartu. Astrofiz. Observ.; 39: 307-20(1971).

P Cygni was observed with medium-dispersion spectrograms taken at the Crimean Astrophysical Observatory during 1968 and 1969. Mass of the emitting volume was 8×10^5 $M_\odot$ and mass of the envelope was $2 \times 10^5 M_\odot$. (W.D.M.)

26225 SOLUTION OF THE EQUATION OF TRANSFER FOR SPHERICAL ATMOSPHERES BY THE METHOD OF GRANT AND HUNT. Viik, T. Publ. Tartu. Astrofiz. Observ.; 39: 3-33 (1971). (In Russian).

The method of solving the equation of transfer elaborated by Grant and Hunt (Mon. Notic. Roy. Astron. Soc., 141: 27(1968)) is extended to the case of a spherical shell atmosphere by approximating the derivative of intensity with respect to μ with the series of Legendre polynomials. A detailed review of general ideas of the method and corresponding formulae are given in order to favor the intelligibility of calculations carried out with this new method of Grant and Hunt. It is shown that, if the shell thickness tends to zero, the method converges to that of Rybicki and Usher (Astrophys. J., 146: 871(1966)) for the spherical case. The connection between the operators of transmission and reflection defined by Grant and Hunt on the one hand and those of Chandrasekhar and the probability of quantum exit defined by Sobolev on the other hand is elucidated both for the rod and plane-parallel slab. Auer and Mihalas (Astrophys. J., 151: 311(1968)) proposed a new method to find the exact temperature distribution in the stellar atmosphere, making use of the radiative equilibrium condition and solving the equation of transfer by the method of Feautrier. It is shown that the somewhat modified method of Auer and Mihalas can also be used in the case when the equation of transfer is solved by the method of Grant and Hunt. (auth)

26226 DISPERSION FORMULA FOR BROADENING OF HYDROGEN LINES FOR EARLY-TYPE STARS. Kuuzik, I. Publ. Tartu. Astrofiz. Observ.; 39: 58-68(1971). (In Russian).

A dispersion profile formula for hydrogen lines as a result of natural, Doppler, and Stark broadening mechanisms is given. The characteristic widths of these mechanisms for Hγ are evaluated for three atmospheres. (auth)

26227 ESTIMATION OF METAL ABUNDANCES IN F DWARFS FROM THE LOW-DISPERSION SPECTRA. Malyuto, V. D. Publ. Tartu. Astrofiz. Observ.; 39: 69-81(1971). (In Russian).

The index δ (the ratio of mean equivalent width of two narrow bands on either side of H_δ to the equivalent width of a narrow band centered on H_δ) was measured in spectra with dispersion 72 Å/mm at H_γ for some F and G dwarfs. The correlations between d (vertical deviations from the relation between δ and V–I for solar-composition stars) and [Fe/H] and different indices of metal abundances were found. It is proposed to measure the index δ (or H_δ index similar to Crawford's H_β index) in order to estimate metal abundances in F dwarfs. (auth)

26228 PERIOD CHANGES OF EPSILON AURIGAE. Albo, Kh. Publ. Tartu. Astrofiz. Observ.; 39: 82-8(1971). (In Russian).

Period changes of ε Aurigae were investigated. As observational material the photometric data of years 1848–1957 were used. The mean moments of eclipses of the star and their mean errors were determined. By use of these moments the mean light elements were found. The deviations O–C are represented graphically. As seen, the period of ε Aur undergoes changes. Assuming the existence of a third body, its mass $m_3 \geq 10^5$ solar masses. Assuming gaseous streams between components, the mass exchange rate turns out to be 10^{22} to 10^{23} g/s, which is of the order of the mass loss of β Lyrae. The following secondary eclipse of ε Aur takes place during the time interval January 1974 to February 1976. (auth)

26229 SPECTRUM OF N DEL 67 AND SOME REMARKS ON CHEMICAL COMPOSITION OF THE NOVAE ENVELOPES. Ruusalepp, M.; Luud, L. Publ. Tartu. Astrofiz. Observ.; 39: 89-105(1971).

The slow nova N Del 67 was under spectroscopic investigation between August and December 1967 and during August 1968. The equivalent widths of absorption and emission lines were deter-

mined. The chemical composition of novae envelopes is discussed. (W.D.M.)

26230 UBV OBSERVATIONS OF CH CYGNI. Luud, L.; Ruusalepp, M.; Kuusk, T. Publ. Tartu. Astrofiz. Observ.; 39: 106-10(1971).

UBV observations were made of CH Cygni starting on Aug. 24, 1968. Curves of variations of V, B − V, and U − B are given. (W.D.M.)

26231 OBSERVATION OF FLARE AND SUSPECTED FLARE STARS. Kuusk, T.; Ruusalepp, M.; Luud, L. Publ. Tartu. Astrofiz. Observ.; 39: 111-15(1971).

Observations made during the 1968−69 season on AD Leo, BD + 31°1048, and HD 36626 are reported. (W.D.M.)

26232 SPECTROPHOTOMETRY OF WOLF-RAYET STARS HD 191765, HD 192163, AND HD 192103. Nugis, T.; Luud, L. Publ. Tartu. Astrofiz. Observ.; 39: 116-36(1971). (In Russian).

The equivalent widths, intensities, and half-widths of spectral lines in the interval 3600 to 4900 Å were determined by medium-dispersion spectrograms. For the red region, equivalent widths were determined using Underhill's published registrograms (1960, 1967). For HD 192163, it was found that variations of spectral lines are possible. The methods of determining electron and Zanstra temperatures are discussed, and temperatures are given. (auth)

26233 MOLECULAR ABUNDANCES IN A SOLAR COMPOSITION GASEOUS MIXTURE. Kipper, T. Publ. Tartu. Astrofiz. Observ.; 39: 321-33(1971).

In constructing model atmospheres for the late-type stars, detailed data about the physical properties of relatively cool gaseous mixtures must be available. The gas pressure and the partial pressures of various molecules are computed as functions of temperature and the electron pressure. (W.D.M.)

26234 MEAN ABSORPTION COEFFICIENT IN THE CALCULATIONS OF MODEL STELLAR ATMOSPHERES. Kruusmaa, A. Publ. Tartu. Astrofiz. Observ.; 39: 273-81(1971). (In Russian).

For the analysis of six nongray model stellar atmospheres with parameters lg T_e = 4.4, 4.5, 4.6, lg g = 4.0 and He : H = 0.0512 (by number of atoms), Planck and Rosseland mean absorption coefficients are calculated. For the same temperature and electron pressure, the Planck mean coefficient is greater than those of Chandrasekhar and Rosseland. Therefore for the same optical depth the electron pressure, obtained with gray distribution of temperature and the Planck mean absorption coefficient, is less. The flux constancy in the surface layers is better for the Planck mean than for the Rosseland one, but the gray temperature distribution corresponds to higher effective temperature. In five iterations somewhat better flux constancy is obtained with the Rosseland mean than with the Planck one. A modification for the mean absorption coefficient is suggested, which behaves as the Planck mean in surface layers and turns into the Rosseland one for great optical depth. (auth)

26235 R CORONAE BOREALIS-TYPE STARS. Krelowski, Jacek (Instytut Astronomii, Torun, Poland). Postepy Astron.; 20: No. 1, 23-36(Jan-Mar 1972). (In Polish).

A description is given of observational facts of R CrB-type variables. Special attention is paid to spectroscopic, infrared, and polarimetric observations. Also, a brief review of hypotheses about the interpretation of the R CrB phenomenon is presented. (auth)

26236 SOME PHENOMENA IN THE T TAU-TYPE STARS. Sikorski, Jerzy (Instytut Astronomii, Torun, Poland). Postepy Astron.; 20: No. 1, 37-50(Jan-Mar 1972). (In Polish).

Some peculiarities in the spectra of the T Tau-type stars are reviewed. These may be caused by regions of atmospheric plasma being not in thermodynamical equilibrium. The intensity of phenomena caused by such plasma depends on the evolutionary stage of the protostar. (auth)

26237 RELATIVISTIC POINCARE LIMITATION FOR SPEED OF ROTATION OF A STAR. Abramowicz, M. (Zaklad Astronomii, Warsaw). Postepy Astron.; 20: No. 1, 59-66(Jan-Mar 1972). (In Polish).

Poincaré (1902) proved that the angular velocity Ω of a rigidly rotating star satisfies the following relation: $\Omega \leq \sqrt{2\pi k\bar{\rho}}$. One can easily verify that this constitutes a special case of a more general condition allowing also for nonrigid rotation: $\bar{\omega} \leq \sqrt{2\pi k\bar{\rho} + \bar{\sigma}^2}$. It is shown that the relativistic counterpart of the condition (N) is of the form: $\bar{\omega} \leq \sqrt{2\pi k(\bar{\rho} + 3\bar{p}) + \bar{\sigma}^2}$. Small perturbations of the equilibrium state caused by an infringement of the Poincaré condition are also discussed. It is shown that in this case: $\bar{\theta} \geq 0$. (auth)

26238 INFRARED DIAMETER OF IRC +10216 DETERMINED FROM LUNAR OCCULTATIONS. Toombs, R. I.; Becklin, E. E.; Frogel, J. A.; (and others) (California Inst. of Tech., Pasadena). Astrophys. J.; 176: No. 2, L71-4(15 Apr 1972).

Lunar occultations of IRC + 10216 were used to determine the size of the regions emitting 2.2-, 3.5-, 4.8-, and 10-μ radiation. The results are interpreted as the first direct measurement of the physical size of a dust shell surrounding a late-type star. (auth)

26239 BD + 40°4124 AND TWO NEARBY STARS. Cohen, Martin (Cambridge Univ. Observatories, Eng. Univ. of Minnesota, Minneapolis). Astrophys. J.; 176: No. 2, L61-4(15 Apr 1972).

Multifilter infrared observations between 2 and 18 μ are presented for BD + 40°4124 and two nearby emission-line stars which show that the 18-μ brightness is the inverse of the visual brightness. (auth)

26240 INFRARED AND OPTICAL OBSERVATIONS OF A YOUNG STELLAR GROUP SURROUNDING BD + 40°4124. Strom, K. M.; Strom, S. E.; Breger, M.; Brooke, A. L.; Yost, J. (State Univ. of New York, Stony Brook). Astrophys. J.; 176: No. 2, L65-70(15 Apr 1972).

Observations of a group of stars surrounding the Herbig Be-type star BD + 40°4124 suggest that this object is the brightest member of a relatively small stellar group. The age of this group is extremely small, probably less than 5×10^5 years. (auth)

26241 RELATIVISTIC SHOCK PROPAGATION AND SEARCH FOR ELECTROMAGNETIC PULSES FROM SUPERNOVAE. Colgate, Stirling A.; McKee, Chester R.; Blevins, Bruce (New Mexico Inst. of Mining and Tech., Socorro). Astrophys. J.; 176: No. 2, L87-91(15 Apr 1972).

An electromagnetic pulse from a supernova occurring within its own magnetic field was previously predicted. Such pulses were searched for and theoretical investigations of the relativistic shock strength in a supernova envelope were continued. The relativistic equations were differenced in characteristic form by using an energy Lagrange frame to calculate the shock and a mass Lagrange frame for the subsequent vacuum blowoff. The results were consistent with analytical solutions and showed that the shock energy factor $\gamma_s \propto \rho^{-0.232} \propto F^{-0.178}$, where ρ = density and F = polytropic mass fraction ahead of the shock. The final expansion increases the kinetic energy factor to $\gamma_f \propto F^{-0.40}$, which results in a cosmic-ray spectrum $N(>E) \propto E^{-2.5}$. The shock energy factor γ_s is now ≈ 70 at breakout (a 1 g cm^{-2} surface layer), which is a factor of 30 less than previously estimated. The expected signal from a supernova at 100 Mpc is reduced from 10^4 kT to ≃ $\frac{1}{3}$ kT for an antenna gain of 4π. Dispersed pulses (0.1 to 100 s per e-fold in frequency) were searched for with a phase-locked loop detector at 4×10^8 Hz, input noise ≃ 10 kT, 3 steradian antenna, and with a frequency tracking receiver at 1.4×10^9 Hz, 1 kT noise and $\frac{1}{4}$ steradian antenna for 10 nights, each with negative results. These null results are consistent with theory. (auth)

26242 ANGULAR-MOMENTUM CHANGES IN ASTROPHYSICAL PROCESSES DUE TO NEUTRINO EMISSION. Tennakone, K. (Univ. of Hawaii, Honolulu). Contract AT(04-3)-511. Lett. Nuovo Cim.; 3: No. 14, 583-4(1 Apr 1972).

It is shown that, in the presence of a very strong magnetic field, a star can gain or lose angular momentum by emitting a large flux of neutrinos. The important effects of this process on neutron stars, pulsars, and collapsing stars are discussed briefly. (L.M.T.)

26243 NUCLEAR SURFACE ENERGY AND NEUTRON-STAR MATTER. Ravenhall, D. G.; Bennett, C. D.; Pethick, C. J. (Univ. of Illinois, Urbana). Phys. Rev. Lett.; 28: No. 15, 978-81(10 Apr 1972).

Direct calculations of the nuclear surface energy are made for a Hamiltonian containing the Skyrme nucleon−nucleon interaction. A plane surface separating nuclear matter and a neutron gas or a vacuum is considered in Hartree−Fock and Thomas−Fermi approximations. These surface energies are incorporated in the compressible liquid-drop model to obtain properties of neutron−star matter. The Hartree−Fock results led to Z values for the nuclei roughly constant at around Z ~ 36 to 38. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 26304 and 26582.

26244 (AD-734377) COUNTS OF INTENSE EXTRAGALACTIC RADIO SOURCES AT 1400 MHz. Bridle, A. H.; Davis, M. M.; Fomalont, E. B.; Lequeux, J. (Owens Valley Radio Observatory, Pasadena, Calif.). 1971. Contract N00014-67-A-0094-0019. 19p. NTIS.

The counts of discrete extragalactic radio sources at different levels of flux density, and their interpretation in terms of cosmological models, have been the subject of controversy for nearly fifteen years. Much discussion has centered on determinations of the exponent γ of the number–flux density relation $N(S) \propto S^{-\gamma}$, where N is the number of sources per steradian whose flux densities exceed S. Counts derived from surveys at frequencies below 500 MHz have indicated that $\gamma > 1.5$ for the intense sources. Counts are derived from accurate 1400-MHz observations of intense sources over a large area of the sky. It is shown that there is little evidence for cosmological evolution contingent on $\gamma > 1.5$ for these sources, but that separation of the counts according to the surface brightness of the sources may lead to a cosmologically significant result. (auth) (NTIS)

26245 (N-71-36147) PULSING X-RAY SOURCE IN CIRCINUS. Margon, Bruce; Lampton, Michael; Bowyer, Stuart; Cruddace, Ray (California Univ., Berkeley. Space Sciences Lab.). [1971]. 8p. (NASA-CR-121889). NTIS.

A pulsing x-ray source with period 685 ± 30 ms was observed in Circinus. Approximately 10% of the 1- to 10-keV x-ray emission of the source is contained in these pulses. A spectrum of the source is presented, and may be fit by a thermal bremsstrahlung emission mechanism with $T = 3.5 \times 10^7$ K, or by a black body at $T = 1.1 \times 10^7$ K, both subject to heavy absorption. (auth) (STAR)

26246 (N-72-12802) LONG-TERM TEMPORAL VARIATIONS OF THE HARD X-RAY FLUX FROM THE CENTAURUS REGION. Schwartz, Daniel A.; Peterson, Laurence E.; Hudson, Hugh S. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Nov 1971. 17p. (NASA-TM-X-65761; X-661-71-445). NTIS.

The x-ray telescope aboard OSO-3 observed the Centaurus region daily from October 1967 to February 1968 and also for five days in June 1968. A stable minimum flux of 0.33 ± 0.03 photons $(cm^2\ sec)/1$ between 7.7 and 38 keV from a source around $l = 305°$ is derived. Several single days show enhanced fluxes, and two extensive flaring episodes, one with a soft and the other a very hard spectrum, lasting at least ten days. (auth) (STAR)

26247 FLUID DYNAMIC STABILITY OF DOUBLE RADIO SOURCES. Blake, G. M. (Cavendish Lab., Cambridge, Eng.). Mon. Notic. Roy. Astron. Soc.; 156: No. 1, 67-89(1972).

The stability of the radio components of double sources confined by the ram pressure mechanism is discussed, and it is shown that they are unstable to the Rayleigh–Taylor and Kelvin–Helmholtz effects. Recent observations have shown a number of sources having component sizes much smaller than their distances from the parent galaxy, and for such sources the growth times of the instabilities are considerably shorter than the time taken for the ram pressure to bring the components to rest in the intergalactic medium. The nonlinear development of the instabilities and the consequences for the evolution of double sources are discussed, and an observational effect suggested. An observational check of the Rayleigh–Taylor instability should be possible in the near future, and confirmation of its occurrence would be a useful test of the deceleration of components, and the ram pressure model in general. (auth)

26248 FAN-BEAM SURVEYS OF RADIO SOURCES NEAR DECLINATIONS $+28^0$ AND $+41^0$. Willson, M. A. G. (Cavendish Lab., Cambridge, Eng.). Mon. Notic. Roy. Astron. Soc.; 156: No. 1, 7-49(1972).

Two strips of sky, of length 9h and 10h in right ascension and about 4° wide (a total of about 0.29 sr), were surveyed at 408 MHz with the Cambridge One-Mile Telescope. Narrower strips centered on the same declinations, +28° and +41°, were also surveyed at 1407 MHz. Catalogs of the 320 detected sources are presented, complete to stated limits of measured flux density which reach minima of 0.6×10^{-26} W m^{-2} Hz^{-1} at 408 MHz and 0.2×10^{-26} W m^{-2} Hz^{-1} at 1407 MHz but are higher away from the centers of the strips. The beam used was a fan-beam of high resolution in declination, $80'' \csc \delta$ and $23'' \csc \delta$ at 408 and 1407 MHz, respectively. The accurate declinations obtained were combined with the accurate right ascensions measured in the 4C survey to seek optical identifications for the 4C sources detected. The new flux density measurements were compared with those of other surveys to investigate the distribution of spectral indices among sources with $S_{408} > 10^{-26}$ W m^{-2} Hz^{-1}, and to search for unusual spectra. (auth)

26249 OHIO SURVEY STATISTICS. Kraus, J. D. (Ohio State Univ., Columbus). Nature (London) Phys. Sci.; 236: No. 62, 4-6(6 Mar 1972).

Reference is made to a fifth installment of the Ohio Sky Survey of radio sources recently published, covering declinations between 40 and 63°N. This increases the total number of sources cataloged from about 8,000 to 12,000 in about 6 sr of sky. Observed number-flux density data for installment 5 sources are tabulated and discussed. (UK)

26250 NEW PROCESSES IN COSMIC RAYS. Allkofer, O. C. (Christian-Albrechts Univ., Kiel). Atomkernenergie; 19: No. 2, 139-48(Apr 1972). (In German).

In high-energy physics the energy range beyond 1 TeV is reserved for cosmic rays. The difficulties that arise in such investigations are shown, and some apparatus used for strong, weak, and electromagnetic interactions is described. There are some new results that have led to the postulation of new processes in particle physics. Difficulties that arise in interpretation of these results are discussed. The momentary activities and future plans of a high-energy physics group working in cosmic rays in Kiel are described. (auth)

26251 ROLE OF PULSARS AS COSMIC-RAY ACCELERATORS. Truemper, J. (Univ., Tuebingen, Ger.). Atomkernenergie; 19: No. 2, 149-51(Apr 1972). (In German).

Discussing the energetics of the Crab nebula and pulsar, as well as the chemical composition of cosmic radiation, it is shown that the observational facts can hardly be reconciled with some current ideas on a direct acceleration of cosmic rays by pulsars. (auth)

26252 VARIABLE X-RAY SOURCE SCORPIUS X-1. Staubert, R. (Univ., Tuebingen, Ger.). Atomkernenergie; 19: No. 2, 153-6 (Apr 1972). (In German).

Sco X-1 is not only the first discovered and brightest extrasolar x-ray source in the Galaxy but also one of the most interesting and extensively studied objects. Observations of Sco X-1 and its optical and radio counterparts as well as theoretical models are reviewed. (30 references) (auth)

26253 MEASUREMENTS OF THE CIRCULAR POLARISATION OF RADIO SOURCES AT 1.4 AND 5 GHz. Roberts, J. A.; Ribes, J. C.; Murray, J. D.; Cooke, D. J. (CSIRO, Sydney). Nature (London) Phys. Sci.; 236: No. 62, 3-4(6 Mar 1972).

Recent measurements of the circular polarization of the radiation from extragalactic radio sources have indicated that the polarization may be variable and that it is greatest for sources with flat or inverted spectra. A series of measurements with the Parkes 64 m telescope, to confirm this, is described. The relationship between theory and observation is also discussed. The observations were made in the summer and autumn of 1971, and for nine of the 37 sources studied, circular polarization was detected at the 4σ level. Results are tabulated. Only one of the sources for which circular polarization was detected showed a "normal" power-law spectrum; all the others showed a high-frequency enhancement with the spectral slope inverted over some frequency range, but detailed understanding of the relation: p of polarization to spectrum is complicated by the presence .. several components in many of the sources. There was a general decrease of polarization with increasing frequency, as predicted by synchrotron theory, but the detailed pattern was quite different from that predicted for a single uniform source in which synchrotron absorption is important, and the results indicate that this theory does not fit the observations. The observed pattern is consistent with predictions where the spectral inversion is caused by the refractive index of the medium rather than by synchrotron self-absorption, but further investigations are necessary. (UK)

26254 MIRCOSECOND INTENSITY VARIATIONS IN THE RADIO SIGNALS FROM PULSARS. Hankins, Timothy Hamilton. San Diego, Calif.; Univ. of California (1971). 127p. University Microfilms Order No. 72-7592.

Thesis.

Observations were made at the Arecibo Observatory of the pulsars CP 0950, CP 1133, and CP 1919 at 111, 196, and 318 MHz. Fine-time resolution was achieved in a bandwidth of 125 kHz by removing the time-smearing effect due to dispersion

in the interstellar plasma. Dispersion is removed before detection by applying the appropriate inverse filter to the pulsar signals, yielding time resolution down to the bandwidth limit of 8 μs. The application of the dispersion removal technique revealed two realms of time structure in the pulses; one was adequately described by the average pulse profile obtained by superposition of many pulses; the other was a strong modulation of the pulse profile with time scales from 600 μs down to the bandwidth resolution limit. Pulses from CP 0950 and CP 1133 showed fine structure shorter than 10 μs at 111 MHz, with occasional peak fluxes of over 40,000 flux units. In the signals from CP 0950 there were occasional trains of quasi-periodic subpulses whose typical period was 600 μs. Removing dispersion from pulses from CP 1919 revealed deep notches in the average pulse profile that have not previously been observed. The existence of microsecond intensity structure, the behavior of the marching subpulses in the signals from CP 1919, and the possibility of variation in dispersion across a single pulse all lead to the conclusion that the emission mechanism and the mechanism that determines the average pulse profile are quite distinct. The capability to resolve much finer detail than previously possible has opened new channels for the study of the pulsar emission mechanism and the propagation of pulsar signals. (Diss. Abstr. Int., B)

26255 OBSERVATIONS AND ANALYSIS OF INTERPLANETARY SCINTILLATION. Zeissig, Gustave Alexander. Ithaca, N. Y.; Cornell Univ. (1971). 245p. University Microfilms Order No. 72-10,541.

Thesis.

Results of an investigation to determine how the radiation from a "point" radio source is affected by passing through the interplanetary medium (solar wind) are presented. This information is desired for two reasons: a knowledge of the interplanetary scintillations (IPS) of a point source permits an estimate of the angular structure of sources with finite angular size, and the parameters of the electron density irregularities in the interplanetary medium responsible for the scintillations may be more accurately defined. An examination of the IPS behavior of 52 extragalactic radio sources is described, and the results are used to make estimates of the angular structure of each source. Observations of flare-related disturbances in the solar wind are described, and velocity limits placed on the particles ejected by the flare. It is shown that approximately one-quarter of the sources have angular structure which may be described as "simple" at meter radio wavelengths, but that all of the sources have finite angular sizes on the order of or greater than 0.01". Measurement of the spectrum of the weak IPS fluctuations for several "simply structured" sources indicates a power-law electron density irregularity spectrum in the range of solar elongations 0.16 A.U. $< p <$ 0.6 A.U. Measured spectra of the strong IPS fluctuations are found to be a very good fit to an exponentially-decreasing function of fluctuation frequency, for solar elongations < 0.10 A.U., which disagrees with all theories assuming a constant streaming velocity for the solar wind. An investigation of the IPS of two pulsars, CP 0950 and NP 0527, is made. The results show that CP 0950 may be considered a "point" source for IPS investigations at meter wavelengths, and an upper limit is placed on its apparent size at 318 MHz due to interstellar scattering of $\lesssim 1'' \times 10^{-3}$. The IPS measurements of NP 0527 indicate that it has an apparent angular diameter due to interstellar scattering of ~0.01", in agreement with theoretical predictions. (Diss. Abstr. Int., B)

26256 THREE EXPERIMENTS IN GAMMA-RAY ASTRONOMY AT CORNELL UNIVERSITY. Albats, Paul. Ithaca, N. Y.; Cornell Univ. (1971). 175p. University Microfilms Order No. 72-7532.

Thesis.

The three experiments discussed represent an effort by the Cornell University Cosmic Ray Group to develop detectors of the highest sensitivity to search for sources of cosmic gamma rays. Different portions of the electromagnetic spectrum are emphasized in each detector. (TSS) (Diss. Abstr. Int., B)

26257 EXTRAGALACTIC RADIO SOURCES. Mills, David Michael. Stanford, Calif.; Stanford Univ. (1971). 81p. University Microfilms Order No. 72-5953.

Thesis.

Compact extragalactic radio sources are assumed to have the following properties: (1) The ram pressure of the external medium is the only significant external force on the cloud boundary, and is equal to the internal pressure. This ram pressure decelerates the source, concentrating the turbulent thermal gas (and the associated turbulent magnetic field) toward the front of the cloud. (2) The directed velocity V is supersonic with respect to the external medium, and a shock front will form. (3) Because the motion is supersonic, the magnetic field which threads the thermal gas trails behind, forming an extended "tail." (4) The relativistic electrons initially have the same distribution as the thermal gas, but then begin to escape into the tail along the magnetic field lines. The bulk escape velocity is limited to the local Alfvén speed by a two-stream instability. On the basis of this model, a large fraction of the emission should originate in a bright, compact (≈circular) region at the front of the cloud, the remainder constituting a long, wide lower surface brightness tail extending back toward the parent object. The contours on the front should be very steep, maximum brightness being reached very near to the leading edge. At moderate resolution, the cloud should appear elongated in the direction of motion, the ratio of length to width being 1:1 to 3:1. Most of the polarized emission must originate in the tail: the intrinsic (zero-wavelength) polarization magnitude should be 5 to 15% with the electric vector perpendicular to the direction of motion. The polarization magnitude decreases monotonically with increasing wavelength due to differential internal Faraday rotation, while the corresponding change in polarization angle is small (≲20°). Due to the escape of relativistic particles, the source luminosity decreases as $e^{-\tau}$, where τ is the ratio of source age to escape time: values of $\tau = 1$ to 10 have been found for typical sources. This leads to a (minimum) mass for these radio clouds (except for Cygnus A) of 10^6 to 10^7 $M_\odot$, with the corresponding kinetic energy being 10^{58} to 10^{59} erg. For Cygnus A, the magnetic field strength (at the front of the cloud) is $10^{-3.8}$ gauss (which is near equipartition), V = 0.11 c, and $\rho_e = 10^{-28.0}$ gm-cm^{-3}. Each cloud has a total mass of $10^{8.4}$ $M_\odot$ and a kinetic energy of $10^{60.5}$ erg. In general, the kinetic energy of a ram-confined cloud must be ~10s/w ~ 100 times the minimum internal energy in magnetic field and relativistic electrons required to account for the observed luminosity. It is emphasized that there is no difficulty in explaining the existence of even the most compact sources (such as 3C 33 and 3C 61.1) by the ram confinement hypothesis. These very compact sources will result whenever a cloud is generated with a relatively small internal energy but ejected at a high velocity. (Diss. Abstr. Int., B)

26258 RADIO INTENSITY FLUCTUATIONS IN PULSARS. Backer, Donald Charles. Ithaca, N. Y.; Cornell Univ. (1971). 254p. University Microfilms Order No. 72-7537.

Thesis.

There exists a wide range of fluctuations in the radio intensity of pulsar emissions. One outstanding feature of these fluctuations in four pulsars is that the intensity variations within one pulse are correlated with those in succeeding pulses. Typically, subpulses of emission appear on the trailing edge of the pulse, drift across the pulse, and disappear on the leading edge of the pulse five to ten pulse periods later. Two immediate questions about this phenomenon are answered—does it occur in other pulsars and are there objects with subpulses drifting in the opposite direction. Some general characteristics of these short-term fluctuations are measured and a nulling phenomenon is discovered. (TSS) (Diss. Abstr. Int., B)

26259 APPLICATION OF THE METHOD OF STATISTICAL ESTIMATIONS IN SOLVING THE PROBLEM OF THE BRIGHTNESS RECONSTRUCTION IN RADIO ASTRONOMY. Sodin, L. G. (Inst. of Radiophysics and Electronics, Erevan). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 14: No. 5, 739-47(1971). (In Russian).

The brightness reconstruction of the radio source, observed using antennas with limited dimensions, is an uncorrected problem (the inverse problem for the first-order equations). In order to solve such problems, the errors must be taken into account. In this connection the inverse problem for the first-order equation in the class of random functions is solved. The solution is sought in the form of functions obtained by the method of statistical estimations. The method takes into account not only the additive but also the other types of noises, in particular, multiplicative. (auth)

26260 CALCULATION OF QUASAR SCINTILLATIONS. Rytov, S. M. (Radiotechnical Inst., Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 14: No. 5, 645-58(1971). (In Russian).

The radio-wave scattering and scintillation of radio sources of small angular dimensions due to small-scale inhomogeneities of the interplanetary plasma are considered. In contrast to calculations based on a model of the equivalent phase screen, the problem is stated for a spatial model of the plasma inhomogeneities and solved in the first approximation of the smooth perturbation method. All the values interesting for comparison with observations are expressed as one-fold quadratures, values of which are calculated by computer at different parameters of the simplest heliocentric model of inhomogeneities. Graphs are given to

systematize quasar-scintillation observation results and refinements of small-scale inhomogeneities of the interplanetary plasma. (auth)

26261 X-RAY AND γ-RAY IMAGING WITH MULTIPLE-PINHOLE CAMERAS USING A POSTERIORI IMAGE SYNTHESIS. Groh, G.; (Philips Zentrallaboratorium GmbH, Hamburg); Hayat, G. S.; Stroke, G. W. Appl. Opt.; 11: No. 4, 931-3(Apr 1972).

An image having considerably increased SNR compared with a single pinhole camera image of starlike sources, may be synthesized from the multiplicity of images recorded at x-ray and γ-ray wavelengths with the multiple-pinhole camera proposed by Dicke, using the method of extended-source Fourier-transform holography. (auth)

26262 HIGH-SENSITIVITY SEARCH FOR X RAYS FROM SUPERNOVA REMNANTS IN AQUILA. Schwartz, D. A.; Bleach, R. D.; Boldt, E. A.; Holt, S. S.; Serlemitsos, P. J. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J.; 176: No. 2, L51-6(15 Apr 1972).

A high-sensitivity scan of the galactic plane was performed from l = 70° to l = 30° to search for 2- to 20-keV x rays from supernova remnants. The spectra of five x-ray sources detected between 44° and 31° longitude are reported, of which only two might be associated with suggested supernova remnants. Upper limits are presented for the 19 possible supernova remnants scanned in this survey. (auth)

26263 HIGH-ENERGY X-RAY SOURCES NEAR THE GALACTIC EQUATOR BETWEEN $l^{II} \sim 335°$ AND $l^{II} \sim 350°$. McClintock, Jeffrey E.; Ricker, George R.; Ryckman, Stanley G.; Lewin, Walter H. G. (Massachusetts Inst. of Tech., Cambridge). Astrophys. J.; 176: No. 2, L57-9(15 Apr 1972).

On October 15–16, 1970 balloon x-ray observations were carried out from Australia. At least two hard x-ray sources (energies > 18 keV) were detected near the galactic equator in the region $\sim 335° < l^{II} < \sim 350°$. (auth)

26264 USE OF LONG-BASE TIME-DELAY MEASUREMENTS IN THE STUDY OF RAPIDLY VARYING X-RAY STARS. Giacconi, Riccardo (American Science and Engineering, Inc., Cambridge, Mass.). Astrophys. J.; 176: No. 2, L79-81(15 Apr 1972).

The existence of time variations on the timescale of 10^{-2} to 10^{-3} seconds in several of the galactic x-ray sources makes it possible to determine their position by simultaneous measurement from two detectors placed at planetary distances, with a precision comparable to any yet achieved in x-ray astronomy. The significance of a search for even faster time variations in the sources is pointed out. If such variations should, in fact, occur, the technique could yield positional information to the order of 0.001". (auth)

26265 OPTICAL OBSERVATIONS OF THE OJ 287 RADIO-SOURCE. Adam, Gilles (Univ. Lyon, Saint-Genis-Laval, France); Floquet, Michele; Marchal, Jacques; Schneider, Michel. Compt. Rend., Ser. B; 274: No. 3, 201-2(17 Jan 1972). (In French).

Photometric observations in the UBV and the spectral range 3000 to 4900 Å were made on a blue object associated with the OJ 287 radio source. (France)

Solar Phenomena

Refer also to abstracts 26233,.26313, and 26350.

26266 (N–71-36127) RADIO SPECTRUM OF TWO ACTIVE REGIONS (RESULTS OF THE TOTAL SOLAR ECLIPSE OF NOVEMBER 12, 1966). Drago, Franca Chiuderi (National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies). [1970]. 30p. (NASA-TM-X-66543). NTIS.

The results of the total solar eclipse of November 12, 1966, observed at 8 different wavelengths between 3 and 21 cm, were studied and the spectrum of two active regions present on the disk was deduced. The shape of the more intense source spectrum presents a maximum at λ ~ 10 cm indicating, at first sight, the nonthermal origin of the emission; it is then shown that the observed flux increase with the wavelength is completely due to geometrical effects. From the Laplace transform of the brightness temperature of the source, the mean and central temperature of the coronal condensation and $\int N^2\,dh$ for the corona (N = electron density) are deduced. (auth) (STAR)

26267 (N–71-37390) STRUCTURAL AND SPECTRAL STUDIES OF SUNSPOTS. Annual Report, September 1, 1970–September 1, 1971. Wyller, Arne A. (Bartol Research Foundation, Swarthmore, Pa.). 29 Sep 1971. 34p. (NASA-CR–122934). NTIS.

The instrumentation and solar observations at the Bartol Observatory are described. The theoretical studies of sunspots are discussed along with the development of a computer program for generating complete profiles of magnetically active lines. (STAR)

26268 (N–71-38549) SUPRATHERMAL ELECTRONS IN A SOLAR ECLIPSE. Final Report. Sharp, G. W. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). [1971]. Contract NASw-2003. 39p. (NASA-CR–123121; LMSC/D–243954). NTIS.

The results of efforts to study the changes in the suprathermal electron flux caused by the total solar eclipse of March 7, 1970 are described. The measurement was made with a retarding-potential analyzer, mounted to view out the side of the rocket on Nike–Apache 14.457, launched from Wallops Island, Virginia at 1336:30 LT, March 7, 1970. For comparison a control experiment was conducted in which an identical analyzer was flown, mounted looking out the side of Nike–Apache 14.456, from Wallops Island at the same local time but on the previous day, March 6, 1970. Differential photoelectron flux in the energy range 3 to 50 eV and in the altitude range 120 to 180 km was measured both during the solar eclipse of March 7, 1970 and the day before at the same local time. The differential electron flux energy spectrum measured within totality had the same shape but was a factor of ten smaller than that measured on the control day for altitudes between 120 and 180 km. This result directly implies that ionizing radiation responsible for the E and F1 ionospheric regions was reduced by a factor of ten during totality. (auth) (STAR)

26269 (N–71-38551) VARIABILITY OF THE INTENSITY RATIOS, PROTONS/ALPHAS, AND ALPHAS/MEDIUM NUCLEI DURING SOLAR PARTICLE EVENTS. Van Allen, J. A.; Venkatarangan, P.; Venkatesan, D. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Aug 1971. Contract N00014-68-A-0196-003. 21p. (NASA-CR–123154). NTIS.

A discussion of the intensity ratio of protons to α particles (p/α) and that of α particles to nuclei with $Z \geq 3$ (α/M) of specific kinetic energy ≥0.5 MeV/nucleon is presented. Satellite observations of nine major solar-particle events give evidence that changes of α/M are caused by changing conditions of the interplanetary medium. Theoretical considerations attribute these changes to reflections of energetic particles by moving magnetic mirrors in the solar plasma, which process also causes Forbush decreases. (STAR)

26270 (N–72-12807) SOLAR ACTIVITY PREDICTION. Slutz, Ralph J.; Gray, Thomas B.; West, Marie L.; Stewart, Frank G.; Leftin, Margo (National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.). Nov 1971. 114p. (NASA-CR–1939). NTIS.

A statistical study of formulas for predicting the sunspot number several years in advance is reported. By using a data lineup with cycle maxima coinciding, and by using multiple and nonlinear predictors, a new formula that gives better error estimates than former formulas derived from the work of McNish and Lincoln is obtained. A statistical analysis is conducted to determine which of several mathematical expressions best describes the relationship between 10.7-cm solar flux and Zurich sunspot numbers. Attention is given to the autocorrelation of the observations, and confidence intervals for the derived relationships are presented. The accuracy of predicting a value of 10.7-cm solar flux from a predicted sunspot number is discussed. (auth) (STAR)

26271 HEIGHT DISTRIBUTION OF SOFT X-RAY EMISSION IN THE SOLAR ATMOSPHERE. Catalano, Charles P. Iowa City, Iowa; Univ. of Iowa (1971). 209p. University Microfilms Order No. 72-8225.

Thesis.

Soft solar x rays were observed simultaneously during a period of 116 days in 1967 by similar equipment on Mariner V and Explorers 33 and 35, the former en route to Venus and the latter two near the Earth. The heliocentric angular separation of Mariner V and the Earth, to a maximum of 54°, permitted the viewing of the Sun from two different directions. Study of the flare-produced emission showed no intrinsic directivity of the x rays within an uncertainty of 12.6%. Occultation of all or part of solar flares beyond the solar limb, as viewed from one spacecraft but not the other, revealed the height distribution of x-ray emission at the time of peak intensity in these flares. An exponential function of the type A exp $(-h/h_0)$ where h is the linear height above the photosphere was fit to these data. The value of $h_0 = 11\ (\pm 4) \times 10^3$ km is an average of values derived from flares in the eastern hemisphere beyond the solar horizon viewed from Mariner V and flares observed in McMath plage regions 9034, 9041, and 9047

beyond the western limb viewed from the Earth. In six clear cases, the height distribution of emission was observed to vary during the time decay phase of the flares. Emission at lower altitudes decayed much more rapidly than at higher altitudes. The effect is attributed to the altitude dependence of electron density. A calculation of simple radiative cooling yields decay rates considerably less than those observed. The dimensions of quiescent x-ray sources associated with McMath plage regions 9034 and 9041 were found by the two spacecraft occultation technique to be a depth of 30×10^3 km by a diameter of 38° in longitude with a minimum height of 20×10^3 km for 9034 and a depth of 20×10^3 km by a diameter of 17° with a minimum height of 15×10^3 km for 9041. (Diss. Abstr. Int., B)

26272 LABORATORY MODEL OF SOLAR FLARES. Baum, Peter Joseph. Riverside, Calif.; Univ. of California (1971). 135p. University Microfilms Order No. 72-10,391.

Thesis.

The results of a number of experiments in the Double Inverse Pinch Device (DIPD) are reported. The DIPD produces a plasma with a line of x-type magnetic neutral points and behaves roughly as described by the theory of Petschek in argon until an abrupt instability occurs. The experiments were carried out in argon, hydrogen, and deuterium. Various modes of pre-ionization were tried and the electric field and current density were measured at the x-point showing a low-resistance phase followed by an anomalously high resistance. A sequence of Kerr cell photographs taken in argon is presented. The entire chamber is visible along the axis of symmetry. Soft x rays were seen to occur simultaneously with the onset of anomalous resistivity in argon. This period was coincident with the time of fast-merging, magnetic field line reconnection, or enhanced flux transfer. Timing was established to show that the x-ray burst follows the x-point current cutoff. Consequently, the x rays were not caused by the high x-point current. They were caused by a small group of higher-energy electrons, which may be accelerated by fluctuating electric fields. Collimation showed that the x rays originate near the x-point at the bottom plate. Large voltage fluctuations were observed also at this time of instability as measured by a floating double electrostatic probe. The power spectrum of the measured potential difference fluctuations was computed in the low-frequency range 2 to 96 MHz, which was below the ion plasma frequency. An upper limit was placed on the neutron flux from d–d reactions under one set of conditions. Measurements were made of ion current above the x-point with a Faraday cup and preliminary experiments with a 127° curved-plate analyzer are reported. The relevance of the experiments to solar flares is discussed, and a number of suggestions for future experiments are presented. (Diss. Abstr. Int., B)

26273 IMPULSE PHASE OF SOLAR FLARES: HARD X-RADIATION ($E \geq 10$ keV), H_α, AND MICROWAVE EMISSION. Vorpahl, Joan Ann. Davis, Calif.; Univ. of California (1971). 109p. University Microfilms Order No. 72-9920.

Thesis.

The variations in hard ($E \geq 10$ keV) x-radiation, Hα and microwave emission during the impulsive phase of solar flares are discussed. It is shown that the rise time in the 20- to 32-keV x-ray spike depends on the electron hardness. About 1% of 1500 x-ray events had from 2 to 5 peaks in one burst, with the spectrum differing for each spike. Furthermore, the impulsive phase is marked by an abrupt, very intense increase in Hα emission in one or more knots of the flare. Properties of these Hα kernels include: (1) a luminosity several times greater than the surrounding flare, (2) an intensity rise starting ~20 to 30 seconds before, peaking ~20 to 25 seconds after, and lasting about twice as long as the hard spike, (3) an effective diameter of 3000 to 6000 km for class ≤1 flares, representing 1/8 to 1/2 of the main flare, (4) a location lower in the chromosphere than the remaining flare, (5) essentially no expansion prior to the hard spike, (6) very steep magnetic field gradients, (7) a position within 6000 km of the boundary separating polarities, often forming on both sides of the neutral line near both feet of the same tube of force, (8) a shape often resembling isogauss contours of the photospheric field indicated on magnetograms and (9) total radiated optical energy less than 1/50 that of the hard electrons. Correspondingly, impulsive microwave events are characterized by: (1) the detection of a burst at 8800 MHz for every x-ray spike if the number of electrons above 100 keV is greater than 10^{33}, (2) great similarity in burst structure with 20- to 32-keV x rays but only at $f \gtrsim 5000$ MHz, (3) typical low-frequency burst cutoff between 1400 and 3800 MHz, (4) maximum emission at $f \gtrsim 7500$ MHz, and (5) the presence of multiple peaks at cm-wavelengths when there are multiple x-ray events, although not all peaks are present at every frequency in the radio flux. Finally the Hα, x-ray, and microwave data are combined to present a picture of the impulsive phase consistent with the above observations. (Diss. Abstr. Int., B)

26274 LATITUDE EFFECTS IN THE SOLAR WIND. Winge, Clarence Richard Jr. Los Angeles; Univ. of California (1971). 113p. University Microfilms Order No. 72-5873.

Thesis.

The Weber–Davis model of the solar wind is generalized to include the effects of latitude. The principal assumptions of perfect electrical conductivity, rotational symmetry, a polytropic relation between pressure and density, and a flow-aligned magnetic field in a system rotating with the Sun, are retained. A flow-aligned magnetic field in the rotating system may be expressed in terms of the flow velocity and density. Rotational symmetry fixes the longitudinal flow velocity V_φ in terms of the flow in the $r-\theta$ plane. Thus, the original three-dimensional magnetohydrodynamic flow problem is reduced to a two-dimensional hydrodynamic flow problem in the $r-\theta$ plane. There are three critical surfaces associated with the equations that supply conditions to determine three of six required boundary conditions. The specified boundary conditions at the base of the corona are the temperature, density, and magnitude of the magnetic field, taken to be constant over a spherical corona. The equations are then expanded about the radial, nonrotating Parker solution, and an analytic solution is obtained for the resulting first-order equations. This solution demonstrates that, to first order, the latitudinal flow velocity V_θ is the product of a radial function and a simple $\sin(2\theta)$ dependence. The first-order solution is then further refined by using the first-order $\sin(2\theta)$ dependence of V_θ as the only necessary approximation required to integrate the exact equations along streamlines. The flair of the streamlines is given by the shape of the radial dependance of V_θ, which is determined by the limit of the equations along the polar streamline. The results show that there is a latitudinal flow toward the solar poles, as a result of magnetic stresses, which persists out to large distances from the Sun. Associated with this flow is a latitudinal component of the magnetic field. The radial flow parameters are, to within small first-order differences, in agreement with those of the Parker and the Weber–Davis models of the solar wind. (Diss. Abstr. Int., B)

26275 OBSERVATION OF A C I EMISSION LINE AT 1993.6 A IN THE SOLAR EMISSION SPECTRA. Samain, Denys (CNRS, Verrieres-le-Buisson, France). Compt. Rend., Ser. B; 273: No. 25, 1133–6(20 Dec 1971). (In French).

The apparatus used to measure the 1993-A neutral carbon line in the solar spectrum is described. The characteristics of the measurements are described: strong reinforcement at the solar periphery and a very strong dependence on solar activity. Other results connected with this observation are also discussed. (France)

26276 SUNSPOT OBSERVATIONS MADE IN 1965. Yilmaz, F. (Istanbul Univ. Observatory). Istanbul Univ. Fen Fak. Mecm., Seri C; 34: No. 1-4, 165-70(Jan-Oct 1969).

From photospheric observations made at the Istanbul University Observatory, observable sunspots and faculae were drawn on a projected disk of the sun and the heliographic coordinates of the sunspots were determined from this drawing. The evolution of sunspot groups observed in 1965 are given. (auth)

26277 OBSERVATIONS OF THE SOLAR CHROMOSPHERE IN 1964–66. Karaali, Salih (Istanbul Univ. Observatory). Istanbul Univ. Fen Fak. Mecm., Seri C; 34: No. 1-4, 153-63(Jan-Oct 1969).

The chromosphere of the Sun was observed at the Istanbul University Observatory during 188 hours and 18 minutes in 1964, 211 hours and 17 minutes in 1965, and 217 hours 03 minutes in 1966 distributed over 171 days, 169 days, and 162 days, respectively. The wavelength of the monochromatic light used was 6563 Å (H_α). The days and the hours of the beginning and ending of these observations, the characteristic numbers of the filaments, and the names of the observers are given along with the beginning and ending time of flares, their importance, and their coordinates. Whenever possible the time of maximum intensity is also noted. (auth)

26278 SUNSPOT OBSERVATIONS MADE IN 1967. Karaali, Salih (Istanbul Univ. Observatory). Istanbul Univ. Fen Fak. Mecm., Seri C; 34: No. 1-4, 31-49(Jan-Oct 1969).

In the photospheric observations made at the Istanbul University Observatory, observable sunspots and faculae were drawn on a projected disk of the Sun and the heliographic coordinates of the sunspots were determined from this drawing. The heliographic coordinates for the sunspot groups observed in 1967 and some other statistical results are given. (auth)

26279 NEW MEASUREMENT OF THE SOLAR GRAVITATIONAL RED SHIFT. Snider, J. L. (Oberlin Coll., Ohio). Phys. Rev. Lett.; 28: No. 13, 853-6(27 Mar 1972).

The redshift of the solar potassium absorption line at 7699 Å was measured by means of an atomic-beam resonance-scattering technique. The shift at the center of the solar disk, corrected for Earth's motion, is $(\Delta\lambda)_{exp} = (1.01 \pm 0.06)(\Delta\lambda)_{theor}$, where the theoretical value, based on the principle of equivalence, is 16.3 mÅ. Further data show negligible center-to-limb wavelength variation for this line. (auth)

26280 LOW-ENERGY SOLAR POSITRONS. Gregory, C. T. (Univ. of California, San Diego, La Jolla). J. Geophys. Res.; 77: No. 7, 1316-22(1 Mar 1972).

It is shown that fluxes of solar particles consistent with measurements of Kinsey (Phys. Rev. Lett., 24: 246(1970)) and demodulated in a manner consistent with the cosmic-ray transport equations (e.g., Gleeson and Axford, 1967) are able to produce low-energy ($T \lesssim 2$ MeV) positrons in the solar atmosphere via unstable CNO β-particle emitters. In the circumstance of a steady state, the solution of an appropriate continuity equation gives a flux of positrons in the solar atmosphere that, when modulated, gives at 1 au a result consistent with the measurement of Cline and Hones (1970), who have found a flux of positrons of 10^{-2} (cm^2 sec ster MeV)$^{-1}$ between 0.5 and 2 MeV. (J.C.W.)

Galaxies

Refer also to abstract 25250.

26281 (AD-733715) COLLISIONAL EXCITATION OF CARBON MONOXIDE IN INTERSTELLAR CLOUDS. Goldsmith, Paul F. (California Univ., Berkeley. Dept. of Physics). 1971. Contract N00014-69-A-0200-1003. 35p. NTIS.

Different models for the collisional excitation of carbon monoxide were investigated by solving the rate equations for the ten lowest energy levels, including stimulated emission and absorption by 3°K isotropic radiation, spontaneous emission, and collisions. The results are qualitatively applicable to other linear molecules. They show that a wide range of rotational excitation temperatures, including population inversions, can be produced by the various kinetic temperatures and particle densities which are likely to occur in the interstellar regions containing molecules. (auth) (NTIS)

26282 (AD-734376) HIGH-RESOLUTION RADIO OBSERVATIONS OF THE GALACTIC CENTER. Ekers, R. D.; Lynden-Bell, D. (Owens Valley Radio Observatory, Pasadena, Calif.). 1971. Contract N00014-67-A-0094-0019. 17p. NTIS.

5-GHz interferometric observations with a resolution of 6 sec × 18 sec arc indicate the presence of compact components in Sagittarius A and in some of the other radio sources in the galactic center region. (auth) (NTIS)

26283 (N-72-13835) VELOCITY DISPERSIONS IN GALAXIES. I. THE SO GALAXY NGC 7332. Morton, Donald C.; Chevalier, Roger A. (Princeton Univ., N. J. Observatory). [1971]. 24p. (NASA-CR-124811). NTIS.

A Coude spectrum of the SO galaxy NGC 7332 with 0.9-A resolution from 4186 to 4364 A was obtained with the SEC vidicon television camera and the Hale telescope. Comparisons with spectra of G and K giant stars, numerically broadened for various Maxwellian velocity distributions, give a dispersion velocity in the line of sight of 160 ± 20 km/sec with the best fit at G8III. The dispersion appears to be constant within ±35 km/sec out to 1.4 kpc (H = 100 km/sec/mpc). After correction for projection, the rotation curve has a slope of 0.16 km/sec/pc at the center and a velocity of 130 km/sec at 1.4 kpc, where it is still increasing. For an estimated effective radius 0f 3.5 kpc enclosing half the light, the virial theorem gives a mass of 1.4×10^{11} $M_\odot$, if the mass-to-light ratio is constant throughout the galaxy. The photographic luminosity is 8.3×10^9 $L_\odot$ so that the M/L ratio is 17. (auth) (STAR)

26284 EFFECT OF INFALLING MATTER ON THE HEAVY ELEMENT CONTENT OF A GALAXY. Larson, R. B. (Yale Univ., New Haven). Nature (London) Phys. Sci.; 236: No. 62, 7-8(6 Mar 1972).

Consideration is given to the consequences of the continuing infall of intergalactic matter on the composition of the interstellar medium and the Population I component of a galaxy, and it is shown that in the presence of infalling matter the heavy element content of interstellar material will tend to approach a constant value that is independent of both the infall and the early history of the galaxy, depending only on stellar evolution processes. The simplifying assumption is made that the total gas content of the galaxy remains constant with time. Several processes contribute to increase or decrease the interstellar heavy-element content. It is assumed that all of the heavy-element enrichment occurs through the ejection of matter from massive stars whose lifetimes are much shorter than the age of the galaxy; the rate of heavy element production is then proportional to the rate of formation of massive stars, which is in turn proportional to the total star formation rate. It is also assumed that mixing of interstellar material is very efficient, so that the heavy element abundance is everywhere the same. It is significant that the asymptotic heavy element abundance is independent not only of time, but also of any initial element synthesis in the galaxy and of the infall rate and turnover time. The asymptotic heavy-element abundance depends only on the stellar mass spectrum and on stellar evolution processes, and may therefore be expected to have considerable universality. It does not seem unreasonable to suppose that about a third of the mass going into star formation is re-ejected from evolving massive stars and that about a tenth of the ejected matter consists of heavy elements. (UK)

26285 X-RAYS FROM A GALACTIC WIND. Burke, J. A.; Hartwick, F. D. A. (Univ. of Victoria, B. C.). Nature (London) Phys. Sci.; 236: No. 62, 4(6 Mar 1972).

There is evidence that the low-energy diffuse x rays in excess of predictions from an extrapolation of the isotropic power-law spectrum observed at higher energies may not be of extragalactic origin. This flux may originate in a hot galactic halo; if this is so, an electron density of $\sim 0.003/cm^3$ is required to produce the observed flux. It seems reasonable to assume that such a halo is a manifestation of a galactic wind, and on this assumption the enhanced x-ray emission expected from the denser nuclear region of the Galaxy is computed. Some observational deviations from galactic wind models are discussed. (UK)

26286 ROCKET SUBMILLIMETER OBSERVATIONS OF THE GALAXY AND BACKGROUND. Pipher, Judith Lynn. Ithaca, N. Y.; Cornell Univ. (1971). 217p. University Microfilms Order No. 72-8988.

Thesis.

On December 2, 1970, at 1:32 MST, Cornell University launched its third successful, rocket-borne, liquid helium telescope from White Sands, N.M. The telescope was carried by an Aerobee 170 to an altitude of 190 km. The nose cone and top lid were ejected +110 seconds into the flight, at an altitude of 120 km, and the six detectors flown could, at that time, view the night-sky emission. This thesis is concerned with the development of, and measurements with the three submillimeter detectors, whose spectral bandpasses were 0.07 to 0.13 mm, 0.2 to 0.45 mm, and 0.4 to 1.5 mm. The far-infrared background in the 0.4 to 1.5-mm band was measured to be $1.3 \pm {}^{0.4}_{0.15} \times 10^{-3}$ watts/cm^2-sr, a value that corroborated past observations within the error, although a new system, a more sensitive detector, and different scan paths differentiated this experiment from previous ones. The isotropy of the background was investigated, and severe limitations on the possibility of emitting atoms or molecules within the Galaxy causing the flux were established. Arguments against the flux being of local or atmospheric origin are presented. Upper limits to the background were established with the other two detectors: the 300-μ limit placed severe constraints on cosmological interpretations of the 1-mm data. Galactic emission at 100μ, at a flux level of 8×10^{-11} watts/cm^2-sr, was found in the anticenter direction. The emission decreased in intensity in the expected fashion, with increasing galactic latitude. This value, interpreted in terms of grain emission, yielded reasonable values of grain number density for a variety of grain models. Features in the Galaxy were also measured, and both H II regions and dusty regions were identified with signal increases. The zodiacal dust emission at 100μ was found to be at a level of 2×10^{-11} watts/cm^2-sr at the ecliptic plane, and is thought to represent emission by particles at 3 AU from the Sun. (Diss. Abstr. Int., B)

26287 STUDIES IN GALACTIC STRUCTURE. Minn, Young Key. Troy, N. Y.; Rensselaer Polytechnic Inst. (1971). 193p. University Microfilms Order No. 72-1206.

Thesis.

The original data of "The Maryland–Green Bank Galactic 21-cm Line Survey" were analyzed. Neutral hydrogen distributions in the Galaxy were examined and best fit models were derived. The hydrogen spiral arms of the Galaxy can be best fitted by an exponential equation, $R = 3.245 \exp(-0.00308\ \theta + 0.14175)\theta$. The pitch angle in this model varied from about 8° in the 3-kpc arm to more than 5° in the Preseus arm. Using model equations of spiral arms and neutral-hydrogen distributions, theoretical line profiles and integrated line of sight hydrogen intensities were calculated and compared with the observational counterparts. (TSS) (Diss. Abstr. Int., B)

26288 GALACTIC STRUCTURE IN CEPHEUS NEAR NGC 7235. Kubinec, William Richard. Cleveland; Case Western Reserve Univ. (1971). 168p. University Microfilms Order No. 72-6311.

Thesis.

Data from a catalogue of objective prism spectral types, photographic V magnitudes, and B−V color indices for approximately 1500 stars brighter than V = 13.0 are used to study the galactic structure in an eight square degree region, centered at l = 103°, b = 0° (new galactic coordinates are used throughout). These data are complete to about V = 12.0. Space density analysis for the seventy-eight OB stars indicate the presence of the Cepheus extension of the Perseus spiral arm at a distance of 3.4 kpc. The interstellar absorption is relatively uniform over the region to a distance of 1.4 kpc where A_V = 1.56m. Beyond 2.5 kpc, the absorption is higher above the galactic plane than below it. At 3 kpc this difference is 0.4m, while at 5 kpc it is 1.2m. This asymmetrical distribution of reddening material appears to be related to the HI distribution in this direction. (TSS) (Diss. Abstr. Int., B)

26289 TIDAL INTERACTIONS IN MULTIPLE GALAXIES. Clutton-Brock, Martin. Seattle; Univ. of Washington (1971). 239p. University Microfilms Order No. 72-7330.

Thesis.

The simulation of galaxies of stars requires an effectively collisionless system. Instead of using a very large number of stars, one can calculate a smoothed approximation to the gravitational field: then one can have an effectively collisionless system with only a few hundred stars. Computer experiments were performed on the tidal perturbations of self-gravitating disks by a fixed-potential perturber. The stars were pulled out into diffuse clouds: the high-velocity dispersion needed for stability made the formation of narrow filaments impossible. Gas clouds have a much-lower velocity dispersion. A zero-velocity dispersion, zero-mass component was placed on top of the stellar disk to mimic the behavior of gas clouds. The gas clouds did indeed form remarkably narrow tails and well defined bridges. (TSS) (Diss. Abstr. Int., B)

26290 STRUCTURE AND EVOLUTION OF THE GALAXY. Proceedings of the NATO Advanced Study Institute Held in Athens, September 8–19, 1969. Mavridis, L. N. (ed.). Astrophysics and Space Science Library, Volume 22. New York; Springer-Verlag New York Inc. (1971). 319p. $21.80. (CONF-690985).

In the seventeen lectures presented, an attempt is made to give a general outline of the structure and evolution of the Galaxy. (W.D.M.)

26291 ECLIPSING BINARIES IN OTHER GALAXIES. Kreiner, Jerzy M. (Obserwatorium Astronomiczne, Krakow). Postepy Astron.; 20: No. 1, 51-8(Jan-Mar 1972). (In Polish).

Problems connected with the investigations of eclipsing binaries in other galaxies as well as the main results of observations are presented. A description of Gaposchkin's method of determination of parallaxes of eclipsing binaries is also given. This method may be used as an independent method of determining the distances to nearby galaxies. (auth)

26292 NUCLEUS OF M82. Kronberg, P. P.; Pritchet, C. J.; van den Bergh, Sidney (Univ. of Toronto). Astrophys. J.; 176: No. 2, L47-50(15 Apr 1972).

Radio observations with the NRAO interferometer were combined with optical observations obtained with the 200-inch (5 m) Hale telescope to study the structure of the nuclear region of M82. Both the radio and the optical observations showed complex structure near the center of M82. There was no detailed correspondence between individual radio components and optical hot spots. In particular it was found that the radio component of highest surface brightness did not coincide with the 10-μ source observed by Kleinmann and Low or with any of the optical superclusters studied by van den Bergh. (auth)

Cosmology

Refer also to abstracts 26591, 26714, and 26759.

26293 (N-71-37395) REVISION OF: COSMIC MATTER–ANTIMATTER ANNIHILATION AND THE GAMMA-RAY BACKGROUND SPECTRUM. Stecker, F. W.; Morgan, D. L. Jr.; Bredekamp, J. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Sep 1971. 58p. (NASA-TM-X-65709; X-641-71-395). NTIS.

Some initial results are presented of a detailed calculation of the cosmological γ-ray spectrum from matter–antimatter annihilation in the Universe. The similarity of the calculated spectrum with the observations of the γ-ray background spectrum above 1 MeV suggests that such observations may be evidence of the existence of antimatter on a large scale in the Universe. Quantitative comparison of the calculations with the existing observations indicates that the product of interacting matter and antimatter densities at present is approximately $\leq 10^{-25}$ cm^{-6}. (auth) (STAR)

26294 CRITIQUE OF REES'S THEORY OF PRIMORDIAL GRAVITATIONAL RADIATION. Jackson, J. C. (Royal Greenwich Observatory, Herstmonceux, Eng.). Mon. Notic. Roy. Astron. Soc.; 156: No. 1, 1P-5P(1972).

Very-long-wavelength universal gravitational waves cannot now produce in clusters of galaxies velocity dispersions greater than that which these systems would possess if they were expanding with the Universe, if the Universe is not younger than 10^{10} yr and Hubble's constant is not less than 50 km/sec/Mpc. A diagram is presented showing that actual velocity dispersions are significantly greater than this limit. (auth)

26295 SEARCH FOR ABSORPTION OF THE SOFT X-RAY DIFFUSE FLUX BY THE SMALL MAGELLANIC CLOUD. McCammon, Dan. Madison, Wis.; Univ. of Wisconsin (1971). 134p. University Microfilms Order No. 72-1042.

Thesis.

An upper limit of 25% is placed on the fraction of the observed 120- to 284-eV x-ray flux that originates beyond the Small Magellanic Cloud if 21-cm measurements of total columnar hydrogen density and the effective absorption cross sections of Brown and Gould are assumed. This result is still consistent with the extragalactic origin of an $E^{-1.4}$ extrapolation of the isotropic x-ray background observed above 2 keV. The excess flux cannot all originate outside of even the local-velocity gas unless an extremely clumpy model of the gas distribution is accepted. (Diss. Abstr. Int., B)

26296 PERTURBATIONS IN A GOEDEL UNIVERSE. Teboul, Michel (Univ., Paris). Compt. Rend., Ser. A; 273: No. 25, 1335-8(20 Dec 1971). (In French).

In order to take into consideration the difficulties encountered in relativistic cosmology when attempting to explain the formation of galaxies, Silk studied the evolution of small perturbations in a Goedel universe. It is shown that the perturbations considered were largely fictitious. The problem is reconsidered using a simplified perturbation model respecting the symmetries of the Goedel universe. (France)

26297 DISK AND RING STRUCTURE IN THE UNIVERSE. Huang, Su-shu (Northwestern Univ., Evanston, Ill.). Sky Telesc.; 43: No. 4, 225-8(Apr 1972).

Ring and disk structures are very widespread in the Universe, and it is shown that the process by which a spherical cloud collapses to a flat disk will be encountered in many aspects. (W.D.M.)

26298 COSMOLOGICAL MODELS WITH PRESSURE AND OBSERVATIONS. Saar, E.; Saar, I. Publ. Tartu. Astrofiz. Observ.; 39: 183-205(1971).

Using the redshift-magnitude relation, the parameters of Friedmann models with pressure are determined. It is shown that, in order to determine the density and pressure parameters with a reasonable accuracy, large redshifts are to be used or an equation of state is to be introduced. The method of finding estimates if the confidence ellipsoids are very elongate is described. (auth)

26299 INHOMOGENEOUS MODEL UNIVERSES. I. BASIC EQUATIONS. Saar, E. Publ. Tartu. Astrofiz. Observ.; 39: 206-33(1971).

Model universes, inhomogeneous on a small scale, are studied. It is shown that the Einstein equations split up into two coupled sets: one of them can be regarded as governing the evolution of inhomogeneities; the other, describing the evolution of the background, is a generalization of the usual Einstein equations for homogeneous universes and contains an extra term arising from the inhomogeneities. When averaged, this term can be considered as an effective energy–momentum tensor, by means of which the feedback of inhomogeneities to the overall dynamics of the Universe is realized. (auth)

26300 INHOMOGENEOUS MODEL UNIVERSES. II. GAUGE INVARIANCE. Saar, E. Publ. Tartu. Astrofiz. Observ.; 39: 234-48(1971).

The invariance of the equations describing inhomogeneous model universes derived in the preceding paper, under coordinate transformations, is studied. It is shown that the expression

of the effective energy–momentum tensor has to be slightly modified in order to make it coordinate-independent. The correctness of the modification is discussed. (auth)

26301 INHOMOGENEOUS MODEL UNIVERSES. III. LORENTZ GAUGE. Saar, E. Publ. Tartu. Astrofiz. Observ.; 39: 249-72(1971).

The equations describing inhomogeneous model universes are studied by using a special gauge and supposing the fluctuating fields to be stochastic. It is shown that the effect of inhomogeneities on the overall behavior of the model is to give rise to a negative "cosmological pressure" and the phenomenological "internal energy." (auth)

26302 DETERMINING THE PARAMETERS OF COSMOLOGICAL MODELS. Saar, E. Publ. Tartu. Astrofiz. Observ.; 39: 171-82(1971). (In Russian).

The application of the least-squares method to determine the parameters of cosmological models is considered. As the accuracy of the estimates is small, it is important to find their confidence levels. It is useful to minimize the sum of the squared deviations Φ in two steps, estimating first the scale parameter and looking in the second step for the estimate of the essential parameters and its confidence regions. It is shown that if the relation, the parameters of which are to be estimated, is linear in the parameters or can be reduced to a linear one by a parameter transformation, the confidence regions are bounded by the equisurfaces of Φ. The corresponding confidence levels are given by the Fisher distribution function $F_{m,N-m-1}$ of the argument $\beta = (\Phi - \Phi_{min})/\Phi_{min}$. Here N is the number of observations and m the number of the essential parameters. This result agrees very well with Solheim's (1966) numerical experiment. (auth)

26303 ISOTROPIC MODELS OF A RADIATIVE UNIVERSE. Krempec, J.; Krygier, B. (Pracownia Astrofizyki, Torun, Poland. Instytut Astronomii, Torun, Poland). Postepy Astron.; 20: No. 1, 67-77(Jan-Mar 1972). (In Polish).

Solutions of the field equations and the equations of the geodetic lines of the light rays are given for both a closed and open isotropic radiative Universe. The light rays move on circular orbits in a closed world and on hyperbolic orbits in an open one. For a semiclosed world it is not possible to tie up the external and internal metrics. This suggests that these worlds are not real. (auth)

26304 CONSTRAINT OF ASTROPHYSICAL SOURCES OF GRAVITY WAVES. Partridge, R. B. (Haverford Coll., Pa.); Wrixon, G. T. Astrophys. J.; 176: No. 2, L75-8(15 Apr 1972).

A refined search was conducted for pulses of microwave emission arriving at the times Weber reports pulses of gravitational radiation. Two radiometers 100 km apart tracked both the galactic center and the Crab Nebula. The low upper limit set on the microwave flux imposes an interesting constraint on possible models for the source of the events observed by Weber. (auth)

26305 INNER BREMSSTRAHLUNG AS A SOURCE OF X-RAYS IN THE STEADY-STATE UNIVERSE. Petrosian, Vahe; Ramaty, Reuven (Stanford Univ., Calif.). Astrophys. J.; 176: No. 2, L83-5(15 Apr 1972).

It is shown that because of inner bremsstrahlung from neutron decay, the steady-state Universe with neutron creation in diffuse regions is inconsistent with x-ray observations around 100 keV, unless the particle density of the Universe is less than about 10^{-7} cm^{-3}. (auth)

26306 FIRST APPROXIMATION TO THE EFFECT OF EVOLUTION ON q_0. Tinsley, Beatrice M. (California Inst. of Tech., Pasadena. Carnegie Institution of Washington, D. C. Univ. of Texas, Austin). Astrophys. J.; 176: No. 2, L93-7(15 Apr 1972).

Because the spectral energy distributions of nearby giant elliptical galaxies are inconsistent with a very steep initial luminosity function, their rate of evolution must be such as to move the magnitude–redshift relation to an apparent value of q_0 at least 0.5 greater than its true value. This conclusion is true even at small redshifts, and it is consistent with the observed slow evolution in color of giant elliptical galaxies. (auth)

26307 QUALITATIVE COSMOLOGY: DIAGRAMMATIC SOLUTIONS FOR BIANCHI TYPE IX UNIVERSES WITH EXPANSION ROTATION, AND SHEAR. II. THE GENERAL CASE. Ryan, Michael P. Jr. (Univ. of Maryland, College Park). Ann. Phys. (N. Y.); 68: No. 2, 541-55(Dec 1971).

An investigation of expanding, rotating, shearing Bianchi Type IX universes was extended to the most general possible case. As in a previous paper, the techniques of Arnowitt, Deser, and Misner were used, and it is shown that the conclusion made in that paper is true in general, i.e., rotation changes the singularity of Type IX universes very little. (auth)

26308 MATTER–ANTIMATTER PHASE TRANSITION: A DERIVATION OF THE CRITICAL TEMPERATURE. Aldrovandi, R.; Caser, S. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nucl. Phys.; B38: No. 2, 593-9 (1972).

A new estimate of the temperature of the matter–antimatter phase transition in the black-body radiation is given, using the theoretical nucleon–antinucleon phase shifts computed in a previous work. (auth)

Planetary Phenomena

Refer also to abstracts 25636 and 26330.

26309 SURFACES AND INTERIORS OF PLANETS AND SATELLITES. Dollfus, A. (ed.). New York; Academic Press Inc. (1970). 576p. $25.00. (In French and English).

New information on solid bodies in the solar system resulting from improvements in optical, radio, and radar astronomical techniques and space exploration is reviewed. The ten chapters include a high-level analysis of present knowledge in planetary physics under the following titles: Determination of Masses of Planets and Satellites, (In French); Diameters of the Planets and Satellites, (In French); Radar Studies of the Planets; Thermal Radio Emission of the Planets and Moon; Photometry of the Planetary Surfaces, (In French); Photometry of Asteroids; Physical Properties of Saturn's Rings; Internal Constitution of Terrestrial Planets; Planetary Magnetic Fields; and The Surface Environment and Possible Biology of Mars. (J.C.W.)

26310 TIME OF FORMATION OF THE EARTH'S CORE. Oversby, V. M.; Ringwood, A. E. (Australian National Univ., Canberra). Nature (London); 234: No. 5330, 463-5(24 Dec 1971).

Some experimental work is described that was designed as analogous to the process of core formation in the Earth, as envisaged in various theories. These theories are briefly enumerated, and it is stated that most of them have maintained that accretion occurred relatively slowly (over about 10^8 yr), so that the gravitational potential energy was radiated away and the Earth formed in a relatively cool and unmelted condition. Subsequently, heating by long-lived radioactive elements occurred, leading to melting of the metal phase and segregation of the core. Differentiation and core formation may thus have occurred much later than the primary accretion. Alternative theories, on the other hand, have maintained that much of the accretion occurred under high-temperature conditions and that core formation occurred either during accretion or very soon afterwards. As a result of the experimental work and discussion presented, it is concluded that the time interval between accretion and core formation was relatively short and most probably smaller than 10^8 yr. Core formation could, in fact, have occurred simultaneously with accretion. This strongly favors models in which much of the accretion occurred under sustained high-temperature conditions, and renders unlikely those theories that regard the Earth as having accreted in a cool and unmelted state, followed by radioactive heating, ultimately culminating in core formation at a much later stage. (UK)

26311 NARROW BAND CHARACTERISTICS OF JOVIAN L-BURSTS. Barrow, C. H. (Univ. of the West Indies, Kingston, Jamaica). Icarus; 15: No. 3, 486-91(Dec 1971).

Radio observations of Jupiter were made during three apparitions using several receivers, each tuned to a slightly different frequency close to 18 MHz. Total power and left- and right-hand polarization components were compared, for L bursts, over various narrow-frequency bands from 0 to 400 kHz and a list of characteristics is presented. Several interesting new features were observed in addition to those listed by Douglas and Smith (1967) which were generally confirmed. Sequences of oppositely polarized bursts were seen, as well as differences in polarization mode between channels 400 kHz apart. Occasionally, isolated bursts of durations 1 to 2 sec were found to show real drifts in frequency, as distinct from the apparent drifts shown by changing intensity across a group of features. Structural and intensity differences could be seen occasionally for short periods across bands as narrow as 40 kHz and quite often when the receiver separation was 80 kHz or more. There were indications of the presence of modulation lanes of the type reported from swept-frequency observations by Riihimaa (1970) although, at present, these cannot be identified unambiguously. (auth)

26312 IDENTIFYING RELEVANT SCIENTIFIC GOALS IN PLANETARY EXPLORATION. Hennes, John P.; Fulmer, Charles V. (Boeing Co., Seattle). J. Spacecraft Rockets; No. 3, 205-13(Mar 1972).

The scientific goal of understanding the origin and evolution of the solar system is examined in terms of the various processes that have led to the development of the solar system, planetary interiors and surfaces, and planetary atmospheres. A scientific rationale for identifying relevant goals and objectives in planetary exploration and an evaluation scheme for making value judgements are outlined, and some particular examples are given. Analysis of outer-planet exploration missions shows that an orbiter of Jupiter has a scientific value about 4 times that of a flyby of Jupiter and about 0.8 that of a fully instrumented entry probe into Jupiter. Missions and payloads can be selected rationally on the basis of their relevance to our fundamental scientific goals in space. Continued public support of solar system exploration can be encouraged by the participation of the space science community in a logical, publicly visible, and accountable selection analysis. (auth)

26313 SOLAR-WIND FLOW PAST THE PLANETS EARTH, MARS, AND VENUS. Rizzi, Arthur William. Stanford, Calif.; Stanford Univ. (1971). 211p. University Microfilms Order No. 72-5982. Thesis.

The hydromagnetic theory of solar-wind flow past the Earth has been extended and modified so as to be applicable to nonmagnetic planets, such as Venus and Mars, that have a sufficient ionosphere to deflect the solar plasma around the planet and its atmosphere. The principal difference in the analysis stems from the fact that the current sheath that bounds the solar wind away from the planet is formed by interaction with the ionosphere rather than with the geomagnetic field as in the case of the Earth. After the principal assumptions and equations are stated, the theory is applied to determine the shape of the ionosphere boundary, or ionopause, across which the Newtonian approximation for the pressure of the flowing plasma is balanced by the pressure of a stationary ionosphere. Examination of the results reveals a correspondence rule that enables results presently available for the location of the bow wave and the properties of the flow about the Earth's magnetosphere to be converted rapidly into those for a nonmagnetic planet by a simple relabeling of the scales. The results are compared with observations made by Mariner 5, and data from Mariners 4, 6, and 7 indicates that Mars has a sufficient ionosphere for the theory to be applicable and that the observed position of the Martian bow wave is exactly predicted by the theory. A more refined analysis of solar-wind interaction with the Earth, Mars, and Venus in which the complete nondissipative equations of magnetohydrodynamics for the steady flow of a perfect gas are solved without any simplification is then carried out for the case of the magnetic field aligned with the flow direction. Furthermore, for Mars and Venus the exact shape and location of the ionopause is calculated using the hydromagnetic theory without introducing any mathematical approximations. Solutions of this improved theory are computed. (TSS) (Diss. Abstr. Int., B)

26314 MAGNETIC-FIELD ANOMALIES IN THE LUNAR WAKE. Whang, Y. C. (Catholic Univ. of America, Washington, D. C.); Ness, Norman, F. J. Geophys. Res.; 77: No. 7, 1109-15 (1 Mar 1972).

The interplanetary magnetic field is only slightly perturbed by the presence of the Moon in the solar-wind flow. A statistical study of the umbral increases and penumbral decreases and increases was conducted with variation of the solar-wind plasma β value, the distance from the Moon and the selenographic longitude of the limb regions of the lunar surface in the solar-wind flow. All lunar-wake anomalies show a strong positive correlation with the plasma β value, whereas only penumbral increases show a marked variation with distance from the Moon. There is no clear correlation of occurrence of penumbral anomaly with selenographic longitude of the exposed lunar limb in the solar-wind flow. (auth)

26315 MEASUREMENT ON THE LUNAR SURFACE OF IMPACT-PRODUCED PLASMA CLOUDS. Reasoner, David L. (Rice Univ., Houston, Tex.); O'Brien, Brian J. J. Geophys. Res.; 77: No. 7, 1292-9(1 Mar 1972).

Simultaneous enhancements of low-energy ions and negative-particle fluxes due to the impact of the Apollo 14 lunar module were observed by the lunar-based charged-particle lunar-environment experiment (CPLEE). The impact occurred 66 km away from CPLEE, and the time delay between impact and flux onset was approximately 1 min. It is argued that the observed charged particles could not have energized at the instant of impact but rather that the impact produced expanding gas clouds and that constituents of these clouds were ionized and accelerated by some continuously active acceleration mechanism. It is further shown that the acceleration mechanism could not have been a static electric field but rather is possibly a consequence of interaction between the solar wind and the gas cloud. (auth)

26316 DEPTH OF SOURCES OF GRAVITY ANOMALIES. Allan, R. R. (Royal Aircraft Establishment, Farnborough, Eng.). Nature (London) Phys. Sci.; 236: No. 63, 22-3(13 Mar 1972).

The matter as to whether the Earth's gravity anomalies can reasonably arise from density variations at a single depth is discussed. An alternative approach is that the anomalies arise from many independent density variations. The mantle transition zone is an obvious possible source of density variations. The first step at ~400 km is usually interpreted in terms of the phase transition from olivine to spinel, and the second step at ~700 km in terms of the further breakdown of spinel to its constituent oxides, each step being accompanied by a density increase of $\sim 0.3^2/cm^3$. (UK)

26317 INTERPRETATION OF GLOBAL GRAVITY ANOMALIES. Bott, M. H. P. (Univ. of Durham, Eng.). Nature (London) Phys. Sci.; 236: No. 63, 23-4(13 Mar 1972).

A reply is made to the criticisms of Higbie and Stacey (Nature Phys. Sci., 234: 130(1971)) of the author's paper (Earth Planet. Sci. Lett., 11: 28(1971)) on an interpretation of global gravity anomalies based on varying depth to the olivine–spinel phase transition of the mantle transition zone caused by lateral temperature variation at this depth. (UK)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 27210.

26318 IONOSFERNYE IZMERENIYA. (Ionospheric Measurements). Galkin, A. I.; Erofeev, N. M.; Kazimirovskii, E. S.; Kokourov, V. D. Moscow; Izdatel'stvo Nauka (1971). 175p.

Apparatus and techniques of radiophysical measurements of ionospheric plasma parameters are reviewed. Pulsed radiosounding of the ionosphere with Earth-based equipment, as well as artificial satellites, is discussed. Measurement techniques include the use of coherent frequencies, radio-wave scattering in the ionosphere, radio location of meteoric traces, F scattering, radio-signal propagation behavior, and absorption coefficients. The use of ionospheric data and the practice of radio communication are considered. (230 references) (K.S.W.)

26319 EQUATIONS OF DIFFUSION COMPONENTS OF A PLANE STRATIFIED PLASMA (IONOSPHERE). Ginzburg, E. I.; Kim, V. F. (Inst. of Geology and Geophysics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 14: No. 10, 1477-83(1971). (In Russian).

The diffusion equations are derived for ion components of two-ion plane stratified magnetoactive plasma (ionosphere). It is shown that the ion admixture undergoes a strong drift by the main ion component with the velocity of the order of the ambipolar diffusion velocity. In the particular case of a single-ion plasma in the diffusion equation, the wind effect and the presence of the altitude temperature distribution are taken into account. (auth)

26320 USE OF THE FREQUENCY COEFFICIENT DEPENDENCE OF RADIOWAVE ABSORPTION IN THE IONOSPHERIC D LAYER TO FIND N(h) PROFILE. Belikovich, V. V.; Itkina, M. A. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 14: No. 10, 1471-6(1971). (In Russian).

Using the generalized index of the frequency dependence of the absorption, $n(\omega)$, the problem is formulated to find the N(h) profile. The solution for N(h) is obtained in the form of a Gaussian curve for the case when $n(\omega) = n_0 - (m/2)\ln(\omega/\omega_*)$. The method is illustrated by the example of restoration of N(h) profile given in the form of $1/\mathrm{ch}(z/2)$. (auth)

26321 COMPLEX ROCKET EXPERIMENT: SUN–ATMOSPHERE. Ivanov-Kholodnyi, G. S.; Kazachevskaya, T. V. Vestn. Akad. Nauk SSSR; No. 11, 50-6(Nov 1971). (In Russian).

Evidence of geomagnetic storms is discussed, and their characteristics are described. Their investigations with a complex system of rocket experiments, "Sun–Atmosphere," are outlined. The latter program provides for the daily firing of four rockets: two for measurements in the range 80 to 170 km, and two for 20 to 100 km. The central problem is the study of changes in the ionosphere, and a typical goal is the determination of the rate of ion formation/cm^3 as a function of altitude from 100 to 150 km. The intensity of corpuscular radiation at, e.g., 86 km as a function of time in days or weeks is of great interest. Temperature profiles of the atmosphere to 100 km are correlated with the prevailing global winds at different times of the year. The second series of the "Sun–Atmosphere" experiments was conducted from the end of September into early October, 1971. (K.S.W.)

26322 MORFOLOGIYA I FIZIKA POLYARNOI IONOSFERY. (Morphology and Physics of the Polar Ionosphere). Isaev, S. I. Leningrad, Izdatel'stvo Nauka Leningradskoe Otdelenie (1971). 268p.

The collection of 30 articles focuses attention on various types of auroral phenomena: mechanism of electron acceleration and the associated energy spectrum; the time dependence of the energy of auroral protons, sporadic ionization of the F2 layer; and radio wave absorption and reflection. Other topics considered of importance are: the movement of polar aurora and electrical fields in the magnetosphere, resonant oscillations of the magnetosphere, electron concentration profiles, and ionospheric excitation at low latitudes. (K.S.W.)

26323 KOMPLEKSNYE ISSLEDOVANIYA POLYARNOI IONOSFERY. (Comprehensive Study of the Polar Ionosphere). Isaev, S. I. Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1970). 184p.

Morphology of the ionosphere in the auroral zone, studies of auroras, their classification, and their relation to solar-activity cycles and magnetic activity are examined in this collection of 20 articles on the polar ionosphere. Other articles are concerned with absorption and reflection of radio waves, ionization by electrons and protons, electron concentration and ionization drift in the F region, x-ray bursts and x-ray absorption, and cosmic radiation. (K.S.W.)

26324 POLARISATIONS OF Pc1 MICROPULSATIONS PROPAGATED THROUGH IONOSPHERIC DUCTS. Fraser, B. J.; Summers, W. R. (Univ. of Newcastle, Australia). Nature (London) Phys. Sci.; 235: No. 61, 170-1(28 Feb 1972).

Studies are described on Pc1 geomagnetic micropulsation polarization characteristics conducted at low-latitude stations in Australia and N.Z. Particular attention is paid to the polarization characteristics, in the plane of the Earth's surface, of fine-structured Pc1 hydromagnetic emissions and whistlers. The studies, the first to be undertaken at low latitudes using data from a network of spaced stations, showed a very consistent polarization pattern. Of greatest interest were events that showed linear polarization. Theoretical work on the propagation of ducted hydromagnetic waves in the geomagnetic meridian has shown that linear polarization in the meridian plane should be observable at the ground, and it has also been suggested that variations from the idealized duct model would introduce polarizations that are nonlinear. This study relates linearly polarized events to specific high-latitude source regions; frequency–time displays of an event are shown. Not all events, however, were linearly polarized and, occasionally, events were observed that indicated linear polarization at one or two stations and elliptical or circular polarization at other stations. It is concluded that the direction of the major axis of linearly polarized hydromagnetic emissions and whistlers is related to the location of a high-latitude source region, provided the ionosphere is relatively stable and the ionospheric dust is uniform. (UK)

26325 ION-EXOSPHERE WITH ASYMMETRIC VELOCITY DISTRIBUTION. Lemaire, J.; Scherer, M. (Belgian Inst. for Space Aeronomy, Brussels). Phys. Fluids; 15: No. 5, 760-6 (May 1972).

The number density, the particle flux, the momentum fluxes, and the energy flux are calculated in a model ion exosphere with an open magnetic field, for an asymmetric Maxwellian velocity distribution (i.e., $\sim\exp[-\beta(v-u)^2]$). Numerical calculations for the polar ionosphere of the earth show that this asymmetry does not qualitatively affect the results obtained with a symmetric velocity distribution function ($u = 0$), i.e., the protons are accelerated outward and escape with a supersonic flow speed. (auth)

26326 SEASONAL VARIATIONS OF THE INITIAL HEIGHT OF THE SPORADIC LAYER E($h'E_s$) AT MEAN GEOGRAPHIC LATITUDES. Samardjiev, D. T.; Serafimov, K. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 24: No. 5, 593-6 (1971).

Data from the Dourbes ionospheric laboratory were used for the 1957–1968 period and compared with experimental data from Bulgarian and East European stations for the analysis at constant zenith angles of the Sun. Two well-defined minima, the one in February–March, the other in November, were observed in the seasonal course of the around-noon values of $h'E_s$. The November minimum was observed in all the years and proved the deepest. The second minimum was observed in 55% of the cases in March and 36% in February and only in April in 1967. Consequently, the first minimum accompanies the beginning of the winter season, while the second coincides satisfactorily with the end of winter. The maxima were observed in winter (equally probable in January and December) and summer (60% of the cases in May and balance in April and June). Results are compared with previous data, where changes of the initial height of the normal layer, $E - h'E$, were investigated. (J.C.W.)

26327 PRELIMINARY RESULTS OF STUDIES OF MOVEMENTS IN THE E REGION. Samardzhiev, D. T.; Spassov, Ch. V. (Inst. of Geophysics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 24: No. 9, 1175-8(1971).

The amplitude fluctuations of a signal from a transmitter in the medium-wave range, with elimination of the ground wave, is recorded to study the air movements and inhomogeneous plasma structure of the ionospheric E region. Three symmetrically located horizontal dipoles, about 40 m long and 12 m high, were used as reception aerials. Regular observations were made from December 1969 to May 1970. Results show the velocity and especially the direction of the movement differ sharply from season to season. The direction of the movement

and its change of 180° from winter to spring are established and show that the predominant current of air masses in the atmosphere above Bulgaria on mesopause levels of 110 to 120 km follows, in winter as well as in summer, the delineations of the Black Sea coastline. (J.C.W.)

26328 ELEMENTAL AND ISOTOPIC ABUNDANCE OF METALLIC IONS IN THE LOWER E-REGION AS MEASURED BY A CRYOGENICALLY PUMPED QUADRUPOLE MASS SPECTROMETER. Krankowsky, D.; Arnold, F.; Wieder, H.; Kissel, J. (Max-Planck-Institut fuer Kernphysik, Heidelberg). J. Mass Spectrom. Ion Phys.; 8: No. 4, 379-90(Apr 1972).

A quadrupole mass spectrometer designed to measure the positive and negative ion composition in the lower ionosphere was used to study the metallic ion population in the lower E region. Ions Na^+, Mg^+, Al^+, K^+, Ca^+, Cr^+, Fe^+, Co^+, and Ni^+ were found. Elemental abundances agree within 30% with those in stony meteorites, suggesting a meteoritic origin of metallic ions in the ionosphere. Na and K possibly are more abundant than in stony meteorites due to a selective evaporation during the ablation process. (auth)

26329 IONOSPHERIC ABSORPTION AND GEOMAGNETIC ACTIVITY. Marcz, F. (Geophysical Research Lab., Sopron, Hungary). Acta Geod., Geophys. Montanistica; 6: No. 1-2, 83-93(20 Oct 1971).

Studies were conducted to establish whether there is any relation between geomagnetic activity and absorption measured in Nagycenk. It was found that there was a relation between average nighttime absorption and magnetic activity. The relation was more pronounced for high frequencies than for low frequencies. Data published for other locations were compared with those measured in Nagycenk, and it was concluded that the relationship varies with geographic latitude also. (JPRS)

26330 ASTROPHYSICAL FLOW PROBLEMS. Johnson, Herbert Eugene. San Diego, Calif.; Univ. of California (1971). 145p. University Microfilms Order No. 72-7593.

Thesis.

Four problems involving astrophysics and space physics are discussed. First, the ^3He balance in the Earth's atmosphere is investigated. The thermal loss of ^3He for the period 1947–1968 is calculated on a daily basis using the Jeans escape formula; nonthermal loss is also estimated. Various sources of ^3He are considered; the most important appear to be auroral precipitation, cosmic dust, interstellar gas, and primordial ^3He. Sources seem to exceed losses. Second, the possibility of an atmosphere on the planet Mercury is discussed. Three models are considered: (1) a thin atmosphere, (2) a thick atmosphere, and (3) an exosphere. The total column content and surface pressures of ^4He, ^{20}Ne, and ^{40}Ar are calculated for the exospheric model. In the third part, the steady, radial flow of a perfect gas in a spherically symmetric galaxy is considered, taking into account the emission of gas from the stars comprising the galaxy and allowing for the presence of a central gravitating source or sink of gas. The equations of motion are reduced to a concise form that involves a single ordinary differential equation for the Mach number in terms of radial distance. A variety of solutions with outward and inward flow is found, including cases in which the flow is partly inward and partly outward. In the final chapter, a simple model that essentially neglects temperature effects, but which includes gravity, radiation pressure, photoionization, and charge exchange, is used to calculate the angular dependence of the intensity of solar Lyman α resonantly scattered from neutral interstellar hydrogen that has penetrated the solar system; the results are then compared with the observations. The resonant scattering of He I λ584 is also treated. (Diss. Abstr. Int., B)

26331 COMPUTER MODEL OF THE BARIUM ION CLOUD EXPERIMENT. Grauer, Albert David. Raleigh, N. C.; North Carolina State Univ. (1971). 99p. University Microfilms Order No. 72-8937.

Thesis.

An examination was made of the plasma dynamics of the Barium Ion Cloud Experiment at an altitude of six Earth radii. The model is developed using infinitely long concentric cylindrical shells to represent the neutral atoms, ions, and electrons in the actual plasma cloud. These infinitely long concentric cylindrical shells are allowed to expand, contract, and rotate. The neutral shells are given an experimentally determined distribution of positions and velocities. They are ionized at random, using the experimentally determined constant for photoionization, to produce ion–electron pairs which are followed using self-consistent equations of motion. The electron shells are followed using the guiding center approximation while the ion shells are followed exactly. The flow of the plasma, in the actual plasma cloud, along the ambient magnetic field lines is accounted for in a natural way. The equations for the electric and magnetic fields satisfy the radiationless Maxwell's equations. The plasma expansion is followed for over 400 sec of real time. The magnetic field, mass density, apparent brightness, average ion position, and average ion velocity are found as tabulated functions of space and time at regular intervals during the course of the experiment. A model of the 900-km barium release conducted in the fall of 1970, a model in which there is no longitudinal flow, and a model in which the electron shells are followed exactly are also examined. In the case of the release at six Earth radii the most important result is the very early return of the magnetic field within the cloud to its ambient value. It can also be concluded from this research that the computer experiment approach is a good one for studying the barium ion cloud and that the guiding-center approximation that is used to follow the motion of the electron shells is valid. (Diss. Abstr. Int., B)

26332 SUPRATHERMAL ELECTRON DISTRIBUTION IN THE IONOSPHERE UNDER WAVE–PARTICLE AND COLLISIONAL INTERACTIONS. Sinha, Ashok Kumar. College Park, Md.; Univ. of Maryland (1971). 199p. University Microfilms Order No. 72-10,086.

Thesis.

A theoretical model is presented to formulate, by a mathematically simplified approach, the relaxation processes of energetic ($\lesssim 10^2$ eV) electrons in the middle and upper ionosphere. The interactions considered are (i) linear wave-particle interaction with existing longitudinal electron plasma oscillations in the ambient plasma and (ii) collisional interactions, including Coulomb, inelastic, and random elastic binary collisions with background thermal particles. The energy transfer rate due to wave–particle interaction is generally seen to be very large ($\sim 10^8$ eV sec^{-1}) in comparison with that due to Coulomb or inelastic collisions ($\sim 10^2$ eV sec^{-1}). However, the former rate vanishes when the electron velocity equals the phase velocity of the plasma wave ("resonance"). A "quasi-stationary" distribution having a dominant resonant peak is obtained using the "relaxation approximation"; and its temporal evolution due to random elastic collisions deduced. Under the assumption of a uniform, continuous influx of the energetic electrons from external sources, a steady-state suprathermal distribution is derived by an asymptotic superposition of the time-dependent solutions. This final distribution is characterized by a maximum in density at about 1 to 2 eV followed by a diminishing tail at higher energies—with significant contributions mostly below 8 eV—and a modulated resonant peak at an assumed resonance energy $\epsilon_0 = 25$ eV. Electron flux density required to sustain the state distribution is estimated to be (1 to 5) $\times$ 10^9 cm^{-2} sec^{-1} corresponding to a constant energy influx rate of about 5×10^{10} eV cm^{-2} sec^{-1}. Probe-current distribution is obtained numerically, and the suprathermal electron effective temperature estimated therefrom is found to be about 3.4×10^4°K (thermal temperature $\approx 2.2 \times 10^{3}$°K). Satisfactory agreement is seen to exist between theoretical and experimental results. (Diss. Abstr. Int., B)

26333 RELATIONSHIP BETWEEN ELECTROSTATIC TURBULENCE AND SPREAD F. Kelley, M. C. (Univ. of California, Berkeley). J. Geophys. Res.; 77: No. 7, 1327-9(1 Mar 1972).

Evidence is presented that shows that turbulent low-frequency electric-field fluctuations are closely associated with the disturbed F region, spread F, and scintillations of radio stars and satellites. A three-axis double-probe electric-field detector was flown on the OV1-17 satellite in a circular polar orbit near the noon-midnight meridional plane at an altitude of about 400 km. Previous investigations are discussed and identify the electric-field signals with spread F as electrostatic. They are isotropic in the moving satellite coordinate system; and they have an amplitude spectrum that varies approximately inversely as the first power of frequency in the range 10 to 500 Hz. (J.C.W.)

26334 DAYGLOW OF Mg I AND Mg II. Gadsden, M. (Aberdeen Univ., Scotland). J. Geophys. Res.; 77: No. 7, 1330-1(1 Mar 1972).

The author feels that the column abundance of 4×10^9 ions cm^{-2} of Mg^+ found by Anderson and Barth (J. Geophys. Res., 76: 3723(1971)) needs considerable revision upward. A factor of 20, which could well be not unrealistic, is needed to bring the relative abundances of magnesium and sodium into accord with the composition of meteors. The data of Anderson and Barth contained the near uv showing the resonance lines of ionized magnesium. The observed radiance, corresponding to approximately 400 R, was interpreted to indicate a column abundance of 4×10^9 ions cm^{-2}, which is approximately equal to that of atomic sodium in the upper atmosphere and no detectable emission at the resonance line of atomic magnesium was found. This ratio of abun-

dance of ionized magnesium to atomic sodium is much lower than that expected to arise from meteoric ablation in the atmosphere and is too high to correspond to the composition of seawater. (J.C.W.)

26335 MESOSPHERIC NITRIC-OXIDE CONCENTRATIONS DURING A PCA. Narcisi, R. S.; Philbrick, C. R.; Ulwick, J. C.; Gardner, M. E. (Air Force Cambridge Research Labs., Bedford, Mass.). J. Geophys. Res.; 77: No. 7, 1332-6(1 Mar 1972).

Day, night, and sunset NO concentrations are derived between 77 and 88 km by utilizing rocket measurements of the positive ion composition and charged-particle densities obtained over Fort Churchill, Canada, during the Nov. 2–4, 1969 PCA. Instead of the expected predominance of water-cluster ions, the positive ions composition between 77 and 86 km is composed almost entirely of NO^+ and O_2^+ during the PCA. These measurements aided the clarification of the ion chemistry of the disturbed D region. The simplified ion composition permits a calculation of NO concentrations from ion-chemical equilibrium relations equating production and loss rates for NO^+ and O_2^+. Through fast chemistry, the ions produced immediately following proton ionization are mostly O_2^+. The NO^+ ions are produced principally by charge transfer of O_2^+ with NO. The derived NO concentrations are within a factor of 2 or 3×10^7 cm^{-3} between 77 and 88 km. The three PCA nitric-oxide profiles exhibit minimums near 84 ± 1 km. There does not appear to be temporal variation in NO during the PCA. (J.C.W.)

26336 FURTHER LOW-ENERGY AURORAL-ION COMPOSITION MEASUREMENTS. Whalen, B. A.; McDiarmid, I. B. (National Research Council of Canada, Ottawa). J. Geophys. Res.; 77: No. 7, 1306-10(1 Mar 1972).

Sounding rocket observations of auroral-ion composition in the premidnight sector during an auroral "breakup" are reported. Proton H^+ and doubly charged helium ions He^{++} were detected above the atmosphere in the 2- to 20-keV energy range, whereas no He^+ ions were observed. Energy spectra of H^+ and He^{++} obtained during the rocket flight were found to be peaked at the same energy per unit charge (6 keV), and the average ion-flux ratio He^{++}/H^+ was determined to be 3%. Maximum intensities of 2×10^5 cm^{-2} sec^{-1} $ster^{-1}$ keV^{-1} for H^+ and 2×10^4 cm^{-2} sec^{-1} $ster^{-1}$ keV^{-1} for He^{++} were recorded at 6 keV per unit charge. These results strongly suggest that the auroral ions originated in the solar wind, were injected into the magnetosphere with approximately the same probability per ion incident on the magnetospheric boundary, and fell through an electrostatic potential of about 6 kV before being detected. (auth)

26337 OBSERVATION OF A LARGE NIGHTTIME GRAVITY WAVE AT ARECIBO. Harper, R. M. (Rice Univ., Houston, Tex.). J. Geophys. Res.; 77: No. 7, 1311-15(1 Mar 1972).

The observation of a large nighttime gravity wave at Arecibo is reported, and velocity and temperature perturbations to the neutral atmosphere are inferred. An increase in the velocity perturbation with height is observed. An anomalous temperature increase occurred when the gravity wave encountered the meridional wind reversal that normally occurs after midnight at low latitudes. (auth)

26338 ECLIPSE AND NONECLIPSE DIFFERENTIAL PHOTOELECTRON FLUX. Knudsen, William C.; Sharp, Gerald W. (Lockheed Palo Alto Research Lab., Calif.). J. Geophys. Res.; 77: No. 7, 1221-32(1 Mar 1972).

Differential photoelectron flux in the energy range 3 to 50 eV was measured in the lower ionosphere both during the March 7, 1970, solar eclipse and during a period 24 hours earlier. The two measurements were made with identical retarding-potential analyzers carried on Nike–Apache rocket flights to a peak altitude of approximately 180 km. The differential electron flux spectrum within totality on the eclipse flight had the same shape but was a factor of 10 smaller in magnitude than that measured on the control day at altitudes between 120 and 180 km, an expected result for an eclipse function decreasing to 1/10 at totality. The differential flux spectrum measured in full Sun has the same general energy dependence as that reported by J. P. Doering, W. C. Fastie, and P. D. Feldman (1970) but is larger by a factor of 2 to 10, depending on altitude. (auth)

26339 LATITUDINAL VARIATION OF DIFFERENTIAL PHOTOELECTRON FLUX AT 560-KILOMETERS ALTITUDE. Knudsen, William C. (Palo Alto Research Lab., Calif.). J. Geophys. Res.; 77: No. 7, 1233-41(1 Mar 1972).

Differential photoelectron fluxes are reported for energies of 14, 23, 42, 79, and 152 eV at an altitude of 560 km, a local time of basically 1200, and a latitude range of 70°S to 60°N. The flux measurements were made with three retarding potential analyzers flown on the OVI-18 satellite. The results presented are restricted to the daylight portions of two nonconsecutive orbits on March 22, 1969. The only latitudinal structure exhibited by the differential photoelectron flux is a decrease of a factor of 2 from high to low latitude. The minimum probably occurs at the magnetic equator. The differential-flux energy spectrum is in satisfactory agreement with what few experimental results have been reported by others. The flux decreases with energy somewhat slower than is predicted by theoretical calculations at the higher energies. The particle and energy fluxes between 8- and 100-eV energy at 560-km altitude derived from the results are 7.7×10^8 cm^{-2} sec^{-1} and 1.3×10^{10} eV cm^{-2} sec^{-1}, respectively. (auth)

26340 HIGH FREQUENECY INDUCED ENHANCEMENTS OF THE INCOHERENT SCATTER SPECTRUM AT ARECIBO. Carlson, Herbert C. (Arecibo Observatory, Puerto Rico); Gordon, William E.; Showen, Robert L. J. Geophys. Res.; 77: No. 7, 1242-50(1 Mar 1972).

Observations are reported of enhancements of the incoherent scatter spectrum excited by strong high frequency (hf) radio waves. A number of enhancement characteristics, observed during an ionospheric heating experiment in January at Arecibo, are described. The enhancement spectrum includes: a strong narrow line displaced below the hf (5.62 MHz) by the frequency of the ion acoustic waves f_i in the plasma (about 4 kHz); a broader line (about 30-kc width) and other weak lines near the hf; and a line near f_i. Enhancements above thermal levels range above a factor of 10^4 and may be taken as verification of the hf excitation of parametric instabilities in the ionosphere. Significant time variations over scales of tens of μsec through hours were seen. Upshifted and downshifted enhanced plasma lines display asymmetries in intensity, width, power dependence, and decay rates (of the order of msec). The O-mode (but not the X-mode) excitation of these enhancements is of significance to heating experiments. (auth)

26341 THERMOSPHERIC STRUCTURE: CORRELATION OF MASS SPECTROMETRY AND INCOHERENT-SCATTER SOUNDING. Giraud, A. (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France); Scialom, G.; Pokhunkov, A. A. J. Geophys. Res.; 77: No. 7, 1251-63(1 Mar 1972).

Results from a day-night pair of rocket flights launched in France in February 1969 to measure neutral composition between 100 and 400 km are analyzed and are compared with data on neutral temperature and density obtained simultaneously from ground-based incoherent-scatter observations. New evidence is thus given of the considerable importance of chemical reactions occurring within rocket-borne mass spectrometers of the type used, and affecting in particular the oxygen measurements. It is concluded that past model atmospheres, based on incorrect determinations of the relative density of oxygen using mass spectrometric data, underestimate O/N_2 slightly, and O/O_2 grossly, at least as far as middle-latitude solar maximum winter conditions are concerned. (auth)

26342 EFFECTIVE HEIGHT-INTEGRATED CONDUCTIVITY OF THE IONOSPHERE. Swift, Daniel W. (Univ. of Iowa, Iowa City). J. Geophys. Res.; 77: No. 7, 1279-85(1 Mar 1972).

The validity of the standard formulas for the height-integrated ionospheric conductivity for problems involving current flow between the magnetosphere and the ionosphere is examined. The problem of the horizontally stratified ionosphere with an oblique magnetic field is studied by use of both an analytic and more realistic numerical model. An electric field harmonically varying in the horizontal direction is assumed at the top of the ionosphere, and an equation for the electrostatic potential within the ionosphere is solved. The height-integrated currents are then calculated from the electric field within the ionosphere. It is found that, down to wavelengths of the order of 10 km, the approximate formulas for the height-integrated conductivity agree very well with the values calculated. The principal conclusion is that the formulas originally derived for the atmospheric dynamo are useful approximations for magnetospheric problems. (auth)

26343 EUV RESONANCE RADIATION FROM HELIUM ATOMS AND IONS IN THE GEOCORONA. Meier, R. R.; Weller, C. S. (Naval Research Lab., Washington, D. C.). J. Geophys. Res.; 77: No. 7, 1190-1204(1 Mar 1972).

The emission of He 584-A and He^+ 304-A radiation from the geocorona was computed assuming resonance scattering of solar radiation. Comparison of these calculations with recent rocket experiments shows that (a) the Jacchia 1970 He model gives the

observed variation of 584 A with altitude and solar zenith angle, but large discrepancies are evident in the absolute value of the emission rate; (b) both the magnitude and the spatial variation of 304 A can be explained by a model that constrains the helium ions to be within the plasmasphere; and (c) an extraterrestrial source of euv radiation is implied by the inability of the models to predict the observed emission rate in the antisolar direction. (auth)

26344 CORRELATED SATELLITE MEASUREMENTS OF LOW-ENERGY ELECTRON PRECIPITATION AND GROUND-BASED OBSERVATIONS OF A VISIBLE AURORAL ARC. Ackerson, K. L.; Frank, L. A. (Univ. of Iowa, Iowa City). J. Geophys. Res.; 77: No. 7, 1128-36(1 Mar 1972).

A comparison of low-energy charged-particle intensities measured with the low-altitude satellite Injun 5 and a ground-based observation of an auroral arc at Fort Churchill on December 21, 1968, during late local evening has established that an intense precipitation band of electron intensities provides the primary energy influx for the auroral light. This precipitation event was located poleward of and adjacent to the trapping boundary for more energetic electron ($E > 45$ keV) intensities. The peak energy fluxes were ~ 10 ergs cm^{-2} sec^{-1} $ster^{-1}$ directed along the local magnetic-field direction into the Earth's atmosphere. Proton and electron intensities similar to those in the plasma sheet in the magnetotail were observed in a substantially less-intense zone positioned equatorward of and adjacent to the trapping boundary. Angular distributions of these particle intensities from the plasma sheet were peaked at pitch angles perpendicular to the local magnetic field. The intense precipitation band of electron intensities poleward of the trapping boundary is interpreted as the signature of direct acceleration of magnetosheath electrons into the Earth's atmosphere. The plasma-sheet proton and electron intensities observed equatorward of the trapping boundary are identified as the "debris" from this intense precipitation band located adjacent to the trapping boundary. (auth)

26345 OBSERVED CORRELATIONS BETWEEN AURORAL AND VLF EMISSIONS. Mosier, S. R.; Gurnett, D. A. (Univ. of Iowa, Iowa City). J. Geophys. Res.; 77: No. 7, 1137-45(1 Mar 1972).

A series of simultaneous observations is presented of very-low-frequency radio noise by the Injun-5 satellite and of visual aurora along the same geomagnetic-field line by the Fort Churchill Auroral Observatory. Seven observations from the period of August 29, 1968, to March 4, 1969, are discussed. In 5 of the 7 events studied vlf hiss is observed in association with auroral-light emissions. These observations typically show the occurrence of vlf hiss in the general region of the auroral arc, with significant changes in the vlf spectrum sometimes observed in the immediate vicinity of the auroral arc. One event for which the associated charged-particle fluxes have been analyzed is investigated in detail. The vlf radio noise intensity for this event is among the largest observed with Injun 5 and is much greater than can presently be explained by an incoherent Cerenkov radiation mechanism. (auth)

Particle Kinetics and Trapping

26346 INFLUENCE OF THE HALL EFFECT ON THE FINE STRUCTURE OF THE MAGNETOPAUSE. Hetzheim, Hartwig (Zentralinstitut fuer Solar-Terrestrische Physik, Berlin). Gerlands Beitr. Geophys.; 80: No. 6, 515-26(1971). (In German).

The influence of the Hall effect on the generation of a magnetic field in the magnetospheric boundary by a perturbation of the solar wind is investigated. A model of the interface between a beam and a magnetic field was made. The generation of a magnetic field transverse to the motion of the beam for a general direction of incidence of the beam is calculated. (tr-auth)

26347 SEARCH FOR SINGULARITIES IN MAGNETIC DISTURBANCE. Yacob, Allapitchay; Bhargava, Bhupendra Nath (Colaba Observatory, Bombay). Gerlands Beitr. Geophys.; 80: No. 6, 503-8(1971).

Extensive daily magnetic data of Alibag were examined for dates around which depressions in the horizontal intensity tend to recur. The search suggests several singularities, the more significant ones being September 4–5 and October 28. An examination of the series of daily values of the index A_p of geomagnetic activity over a 38-year period also suggests a singularity around September 5. (auth)

26348 THEORY OF THE VAN ALLEN BELT. Pizzella, G. (Univ., Lecce, Italy). Nuovo Cim.; 8B: No. 1, 35-52(11 Mar 1972).

A theory of the Van Allen-belt protons is proposed on the basis that ionospheric particles of the Earth are accelerated by stochastic hydromagnetic waves in a cyclotron-resonance mode. Loss mechanisms are: energy loss by Coulomb interactions and particle loss by charge exchange, Coulomb scattering, and wave scattering. A stationary solution of the Fokker–Planck equation in the energy space for the equatorial region is then proposed. The comparison with the available experimental data on the trapped protons shows: a) the ratio of the wave electric field needed to accelerate and the wave magnetic field needed to scatter the particles into the loss cone is equal to the Alfvén velocity, as expected; b) the electric field required for the acceleration is of the order of 10 to 100 $\mu V/m$, depending on the position in space in agreement with direct measurements; and c) the calculated differential energy spectrum for protons describes well the experimental data. (auth)

26349 MECHANISM OF THE RADIATION BELTS OF THE EARTH. Khakimov, F. Kh. (Tadzhik State Univ., Stalinabad, USSR). Dokl. Akad. Nauk Tadzh. SSR: 14: No. 9, 19-22(1971). (In Russian).

A mechanism for the Earth's radiation belts is discussed on a statistical approach rather than the traditional mechanical explanations. An ellipsoidal function is derived that is sensitive to the influence of a magnetic field and leads to a three-dimensional distribution of charged particles. Two zones of such charged particles exist: positive particles predominate at the equator and correspond to an inner radiation belt; negative particles predominate at the poles and it is possible that polar auroras arise from electron leakage from these zones. The boundary line is calculated to be at 72° 32′. (K.S.W.)

26350 RADIATSIONNYI BAR'ER NA PUTI V KOSMOS. (Radiation Barrier to Outer Space). Kuzin, R. A.; Yurgov, V. V. Moscow; Atomizdat (1971). 136p.

A general treatment of the Sun's composition, the pattern of charged particles in the Earth's magnetic field, and the distribution of intensities of protons and electrons is offered. Methods of overcoming the radiation barrier and simplified discussions of rocket ships are included. (11 references) (K.S.W.)

26351 MAGNETIC FLUCTUATIONS IN THE EARTH'S MAGNETOSHEATH IN THE FREQUENCY RANGE 0.01 TO 140 Hz. McLeod, Malcolm George. Los Angeles; Univ. of California (1971). 179p. University Microfilms Order No. 72-2860.

Thesis.

Power spectra and cross spectra of the time derivative of the magnetic-field vector components of the Earth's magnetosheath are presented. The spectra cover the frequency range from 0.01 to 140 Hz. The data were obtained with triaxial search-coil magnetometers flown on the OGO-1 and OGO-3 spacecraft. The distribution of propagation directions for the magnetic fluctuations in the magnetosheath appears to be isotropic when observed in the plasma frame of reference, which is moving relative to the satellite. This is inferred from the cross spectra between pairs of vector components that exhibit typical coherence values of 0.1 as recorded on the satellite and a real coherence (not complex) as shown by coherence phase angles of 0 and 180°. It is shown that these values of coherence magnitude and phase angle may be attributed to the effects of Doppler shifting of fluctuations that have an isotropic distribution of propagation directions in the plasma frame of reference. The finding of an isotropic distribution of propagation directions is rather surprising, as the dispersion curves for a cold plasma would lead to the expectation that the magnetic-field direction would be an eigenvector of the spectral matrix. The explanation may be that a warm plasma with sources relatively close to the satellite exists. The power spectral density of the field components may vary with time by a few orders of magnitude during a single magnetosheath traversal. The power spectrum for the field components changes slope from $1/f^2$ to $1/f^3$ slightly above 1 Hz. A thorough treatment of the theory of power spectra and cross spectra and their estimation from finite samples of data is also given. (Diss. Abstr. Int., B)

26352 STUDY OF THE GEOMAGNETIC DISTURBANCE FIELD ASYMMETRY. Crooker, Nancy Uss; Siscoe, George L. (Univ. of California, Los Angeles). Radio Sci.; 6: No. 4, 495-501(Apr 1971).

Hourly averages of the H component of the low-latitude geomagnetic disturbance field are Fourier-analyzed to obtain the amplitude G and local-time phase φ of the first diurnal harmonic for the one and one-half years of the IGY. The amplitude G is found to correlate roughly with the AE index and, in particular, to exhibit the same storm-time behavior. For major storms, G can exceed 100γ and, in the example shown, exceeds 80γ for an interval of six hours. The phase φ tends to be located near 1800 LT, and this

characteristic is nearly independent of AE. A comparison of the observed phase and that associated with the usual bay return current suggests a two-component model of the disturbance field asymmetry, with one component at a nonbay orientation. The nonbay component is discussed in terms of possible ionospheric and magnetospheric currents. The second possibility seems to require currents located on the plasmapause to sustain the large forces involved in the asymmetry. (auth)

26353 STABILIZATION OF THE TWO-STREAM INSTABILITY IN THE EQUATORIAL ELECTROJET. Sato, Tetsuya (National Oceanic and Atmospheric Administration, Boulder, Colo.). Phys. Rev. Lett.; 28: No. 12, 732-4(20 Mar 1972).

Stabilization of the two-stream instability in a weakly ionized plasma (equatorial electrojet) is studied using fluid equations. It is shown that a macroscopic quasi-linear process acts to reduce the electron flow to a threshold level (ion sound speed), thereby stabilizing the instability. This result gives an explanation of constant Doppler shifts of radar echoes in the electrojet. It is further shown that the saturation level of the fluctuations agrees with that of observations. (auth)

26354 RADIAL DIFFUSION OF ELECTRONS FOLLOWING A GEOMAGNETIC STORM. Tomassian, Albert Dickran. Los Angeles; Univ. of California (1971). 180p. University Microfilms Order No. 72-1517.

Thesis.

Radial diffusion as a source for the moderately energetic electrons of the inner zone was studied. The spatial and temporal variations of the equatorially trapped electrons prior to, during, and after the geomagnetic storm of Day 245 (Sept. 2), 1966 are analyzed. Radial diffusion by violation of the third invariant is assumed to be the transport mechanism causing these variations. The validity of this assumption is tested by comparing the diffusion coefficient resulting from the present analysis with the coefficients determined from other diffusion experiments. The radial diffusion equation derived by Dungey and by Fälthammar is used with a term added to account for particle losses from pitch-angle diffusion. The results of this analysis justify the original assumption that radial diffusion is an important transport mechanism responsible for the temporal and spatial variations of the electrons prior to, during, and after the storm. In addition, during an intense storm, when the diffusion coefficient is enhanced, and after the storm, when the gradients in the electron distributions are enhanced, there results an enhanced radial diffusion rate that can act as a source for the energetic ($E_e < 1$ MeV) inner-zone electrons by first filling the slot region (the region where lifetimes are short) and then rapidly transporting other electrons across it. These inward-diffusing electrons then populate the inner zone, since lifetimes there are long and transport rates very slow. (TSS) (Diss. Abstr. Int., B)

26355 LATITUDE-DEPENDENCE OF PC-TYPE PULSATIONS [IN THE ELECTROMAGNETIC FIELD]. Miletits, Cz. (Geophysical Research Lab., Sopron, Hungary). Acta Geod., Geophys. Montanistica; 6: No. 1-2, 141-53(20 Oct 1971).

Published data from various areas of the world were used to assess the effects of geographic latitude on the Pc-type pulsations in the Earth's electromagnetic field. It was found that the period of these pulsations increased with increasing latitude in most instances and remained constant in a few. The diagram showing the distribution of latitude dependence of micropulsation periods shows three peaks. Of all cases, the period changes were 0 to 1.5° in 34% of the instances, 1.5 to 8.5° in 51% of the instances, and 8.5 to 13.7° in 15% of the instances. (JPRS)

26356 SOME PROPERTIES OF THE SUDDEN COMMENCEMENT OF GEOMAGNETIC STORMS. Le Minh Triet (Eoetvoes Lorand Univ., Budapest). Acta Geod., Geophys. Montanistica; 6: No. 1-2, 29-43(20 Oct 1971).

Conditions for the propagation of hydromagnetic waves in the upper atmosphere, interaction between the solar corpuscular streams and the magnetosphere, occurrence of magnetic storms, correlation between the amplitude and rise time of the sudden commencement of magnetic storms, and simultaneity of the sudden commencement of magnetic storms are discussed. The validity of the theoretical considerations was confirmed on the basis of observational data. The difference of starting times of magnetic storms was found to be a result of the propagation mechanism of hydromagnetic waves in the magnetic field of the Earth. (14 references) (JPRS)

26357 VLF/ELF RADIATION PATTERNS OF ARBITRARILY ORIENTED ELECTRIC AND MAGNETIC DIPOLES IN A COLD LOSSLESS MULTICOMPONENT MAGNETOPLASMA. Wang, T. N. C. (Stanford Research Inst., Menlo Park, Calif.); Bell, T. F. J. Geophys. Res.; 77: No. 7, 1174-89(1 Mar 1972).

With the use of a power integral formulation, a study was made of the vlf/elf radiation patterns of arbitrarily oriented electric and magnetic dipoles in a cold lossless multicomponent magnetoplasma. Expressions for the ray patterns are initially developed that apply for arbitrary values of driving frequency f, static magnetic-field strength $\bar{B}_0$, plasma density, and composition. These expressions are subsequently specialized to vlf/elf radiation in a plasma modeled on the magnetosphere. A series of representative pattern plots are presented for frequencies between the proton (f_{pH}) and electron (f_{eH}) gyrofrequencies. These patterns illustrate the fact that focusing effects that arise from the geometrical properties of the refractive index surface tend to dominate the radiation distribution over the entire range $f_{eH} \geq f \geq 4.6\, f_{pH}$. Focusing effects are particularly strong in the range $\frac{1}{2}f_{eH} \geq f \geq f_{LHR}$, where the major lobe of the pattern lies along $\bar{B}_0$ and the lobe intensity varies inversely as the first power of the distance between source and observer rather than as the square of this distance. It is concluded that focusing effects should be of significant importance in the design of a vlf/elf satellite transmitting system in the magnetosphere. (auth)

26358 LARGE-SCALE COHERENCE AND HIGH VELOCITIES OF THE EARTH'S BOW SHOCK ON FEBRUARY 12, 1969. Greenstadt, E. E. (TRW Systems Group, Redondo Beach, Calif.); Hedgecock, P. C.; Russell, C. T. J. Geophys. Res.; 77: No. 7, 1116-22 (1 Mar 1972).

The Earth's bow shock exhibited a clean laminar profile at low Mach number as it crossed and recrossed Ogo 5, Heos 1, and Explorer 33 on February 12, 1969. The approximate 120 R_E distance between Heos and Explorer during one set of crossings indicated the abrupt character of the laminar shock "front" and the absence of magnetosheath turbulence both in the dayside hemisphere above the ecliptic and in the flank of the shock 75 R_E behind the Earth and below the ecliptic. The abruptness of the shock and the coplanarity of the loci of Ogo and Heos with the local shock normal permit the most reliable estimates yet obtained of shock velocities along the normal. These mean velocities ranged from 11 to at least 100 km/sec over distances of 2 to 7 R_E. (auth)

26359 PRESERVATION OF THE SECOND ADIABATIC INVARIANT DURING CROSS L DIFFUSION. Southwood, D. J. (Univ. of California, Los Angeles). J. Geophys. Res.; 77: No. 7, 1123-7(1 Mar 1972).

In contrast with Haerendel's earlier analyses it is pointed out that drift resonance due to electromagnetic perturbations does not result in violation of the second adiabatic invariant J. A simple disturbance is chosen that suitably isolates the effects that have been suggested as important. When the classical adiabatic theory for motion within the disturbance is used, drifts appear that have been ignored in previous treatments. These drifts, however, reduce to such a form that it is clear they play no role in diffusive processes. (auth)

26360 PHENOMENOLOGICAL STUDY OF LHR HISS. Gross, S. H.; Larocca, N. (Polytechnic Inst. of Brooklyn Graduate Center, Farmingdale, N. Y.). J. Geophys. Res.; 77: No. 7, 1146-56(1 Mar 1972).

The 1963 and 1964 Alouette-1 records from the Ottawa station were studied to determine the statistical characteristics of vlf hiss exhibiting a sharp lower-cutoff frequency associated with the lower-hybrid resonance (LHR). A particular class of midlatitude hiss events were emphasized and designated "S-type hiss." These events have lower-cutoff frequencies that vary smoothly with time, have limited bandwidths, and do not appear to be associated with other vlf phenomena. Their diurnal time of peak occurrence provides evidence that their sources may be connected with the type of magnetospheric activity usually associated with auroral-zone phenomena; yet, they are definitely midlatitude events. A likely means for transporting the electromagnetic energy is a horizontal duct that occurs as a result of the presence of more than one ion species in the topside ionosphere. Nonducted whistler-mode signals may be trapped in the duct, and satellites within the region observe signals with characteristics determined by this guiding structure. Other forms of LHR hiss, such as whistler-triggered events, may also be associated with these ducts. The characteristics of noise at altitudes above such ducts, or in the absence of ducts, may be different from that of S-type hiss. Some of the observed Alouette 1 events may be such nontrapped noises. (auth)

26361 OGO 4 OBSERVATIONS OF EXTREMELY LOW FREQUENCY HISS. Muzzio, J. L. R.; Angerami, Jacyntho J. (Stan-

ford Univ., Calif.). J. Geophys. Res.; 77: No. 7, 1157-73(1 Mar 1972).

An elf hiss band with characteristics not previously identified was observed in data from the Stanford University vlf experiment on Ogo 4. The band exhibits the typical low-frequency cutoff characteristic of downward-propagating hiss and also a peculiar upper cutoff in the vicinity of 600 Hz, which is nearly independent of the satellite altitude (~430 to 900 km) and latitude above ~15°. This band-limited elf hiss (BLH) is observed from ~10° up to 55° dipole latitude, where the nearly constant upper cutoff and the increasing (with latitude) lower cutoff merge. Around ~10° dipole latitude, the BLH exhibits a sloping upper cutoff decreasing in frequency toward the equator (equatorial erosion). The BLH is seen most frequently from ~0600 to ~2200 LT, although some examples have been found between 0200 and 0500 LT, with less intensity. In the range 0 to 3 kHz and up to ~55° dipole latitude, the BLH is the strongest signal observed. Its peak amplitude may reach 2×10^{-4} γ^2/Hz between 40° and 50° dipole latitude during daytime (~1000 LT). After prolonged periods of low magnetic activity (Kp ≤ 2), the upper cutoff may decrease to as low as 420 Hz but recovers about one day after a sharp increase in magnetic activity, such as a sudden commencement. The decrease and smearing of the lower cutoff of the background hiss, observed at latitudes greater than about 58°, is an indication of the light ion trough. A source location in the equatorial region near L = 4 was found adequate to explain the characteristics of the BLH, as well as some of the observations of elf hiss previously reported. Two possible generation mechanisms are briefly examined (Cherenkov and Doppler-shifted cyclotron), but for either a certain amount of emission coherency or amplification is necessary to obtain the observed power fluxes. (auth)

26362 THERMAL POSITIVE IONS IN THE OUTER IONOSPHERE AND MAGNETOSPHERE FROM OGO 1. Ahmed, M. (Regis Coll., Weston, Mass.); Sagalyn, R. C. J. Geophys. Res.; 77: No. 7, 1205-20(1 Mar 1972).

Thermal positive ion densities measured with a spherical electrostatic analyzer aboard Ogo 1 on approximately 25 orbits between September and December 1964 were studied. The charged-particle distributions exhibit a highly variable character within and beyond the plasmapause boundary. The presence of the plasmapause, though quite evident in most cases, is not obvious in some, whereas on a few orbits more than one steep density decrease is observed. The density gradient at the plasmapause varies between 3×10^{-2} and 6.0 ions/cm^3/km. The magnitude of the density gradient is inversely related to the plasmapause L position and is consistently about an order of magnitude higher for the afternoon sector orbits than for the nightside orbits. Within the plasmasphere irregularities are observed on the density distributions in the form of troughs and humps, whereas beyond the plasmapause the irregularities exhibit "wavelike" structures with wavelengths in the range of 0.1 to 0.3 L. The amplitude of these fluctuations is most commonly about a factor of 2 relative to background magnetospheric density; however, excursions from 20% to a factor of 20 are observed. These irregularities do not show any correlation with the level of magnetic activity. A delay of 3 to 9 h is found in the movement of the plasmapause following an increase in the level of magnetic activity on the nightside. Similar studies in the afternoon sector show that the plasmapause location correlates best with the magnetic activity that existed when the sampled plasma was in the formative nightside region rather than with the magnetic activity immediately preceding the plasmapause measurement. (auth)

26363 WAVE PROPAGATION EFFECTS ON OBSERVATION OF IRREGULARITIES IN THE EQUATORIAL ELECTROJET. Kaw, Predhiman K. (Physical Research Lab., Navrangpura, India). J. Geophys. Res.; 77: No. 7, 1323-6(1 Mar 1972).

The refractive effects of unstable waves in an electrojet with a velocity profile are examined theoretically. It is shown that these calculations are relevant to experimental observations of irregularities in the equatorial electrojet. Field-aligned irregularities in the equatorial E region have been investigated in great detail by radar backscatter and rocket experiments in recent years. Balsley (1969) classified the irregularities into two types. Important features of type I can be explained in terms of a two-stream instability that is excited when the electrojet current is sufficiently strong. Type II irregularities have recently been associated with a cross-field gradient instability. The observations of the irregularities may be explained by considering propagation of the excited waves in an inhomogeneous electrojet. The existence of a velocity profile in the electrojet is particularly effective in modifying wave properties as the wave propagates. (auth)

26364 EFFECT OF GEOELECTRIC STRUCTURE ON THE POLARIZATION CHARACTERISTICS OF THE GEOMAGNETIC MICROPULSATIONS. Rankin, D.; Reddy, I. K. (Univ. of Alberta, Edmonton). J. Geophys. Res.; 77: No. 7, 1286-91(1 Mar 1972).

The amplitude and phase changes of the magnetic-field component normal to the strike of a geoelectric inhomogeneity are computed. The effects of the geoelectric inhomogeneity on the polarization characteristics of the geomagnetic micropulsations are illustrated as functions of the distance from the inhomogeneity and of the period of the micropulsation field for linearly and circularly polarized incident fields. (auth)

Solar Wind and Cosmic Ray Interactions

Refer also to abstract 26191.

26365 (TRITA-EPP-72-2) WEAKLY-SHOCKED FLOWS OF THE SOLAR WIND PLASMA THROUGH ATMOSPHERES OF COMETS AND PLANETS. Wallis, Max (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Jan 1972. 26p. Dep. NTIS (U. S. Sales Only).

The quasi-one-dimensional, continuum description of the solar wind's ionizing interaction with neutral atmospheres is employed to give solutions to the upstream, transsonic flow. The subsonic flow is approximated by assuming constant total energy flux. Shocked solutions are found to mass-accreting flows, which pass suitably continuously over to shock-free solutions for low gradients in the ionization rate. Cometary shocks are subcritically weak, so they heat the electrons. They occur inside the ionization region, disturbing the solar wind over the mass-accretion scale length: this directly contradicts the earlier computed solutions, (Biermann et al. 1967), which are judged to be faulty. The shock ahead of Venus can also be subcritical if the relevant density gradient is provided by a suprathermal atmospheric component or if charge–exchange interactions effect rapid cooling of the plasma. (auth) (Sweden)

26366 TERMINATION OF THE SOLAR WIND. McDonough, Thomas R.; Brice, Neil M. (Cornell Univ., Ithaca, N. Y.). Icarus; 15: No. 3, 505-10(Dec 1971).

It has previously been suggested that the solar wind might terminate at distances of 5 to 20 AU from the Sun, and that the solar wind might be drastically slowed down by charge exchange and photoionization of interstellar hydrogen atoms that approach the Sun. However, recent satellite measurements of resonantly scattered Lyman-alpha radiation, together with pulsar dispersion and Faraday rotation measures, imply very small values for the interstellar hydrogen density (0.05 cm^{-3}) and magnetic-field strength (3 μG). As a result, the solar wind is not expected to be slowed down by more than about 30% inside the termination distance, which is expected to be about 100 AU. Analytic solutions for the solar-wind flux and velocity as a function of distance are obtained, yielding estimates of the slowing down and termination distance as a function of the various input parameters (solar-wind flux, velocity, solar Lyman-continuum flux, interstellar hydrogen density and velocity, and magnetic-field strength). (auth)

26367 ELECTRON PRODUCTION RATE OF SECONDARY COSMIC RAYS IN THE COSMIC RAY LAYER. Velinov, P. I. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 24: No. 5, 597-600(1971).

Primary cosmic radiation interactions with atmospheric nuclei form different kinds of secondary cosmic radiation. Particles moving in an upward direction, inverse to that of primary particles, represent splash albedo. Some of these particles after leaving the atmosphere, may become trapped by the geomagnetic field, re-enter the atmosphere, and are termed re-entrant albedo. A study was made of the contribution of secondary particles and x rays for the total intensity in the cosmic-ray layer. The total intensity is a sum of the primary and secondary intensities, intensities of the re-entrant and splash albedo, intensity of the primary CR photons, intensity of the secondary x rays, and intensity of the x-ray albedo. It is concluded that 93% of the primary ionization is produced by these intensities, and that these results show that values of electron production are probably twice as high as those heretofore calculated and apply to other latitudes. (J.C.W.)

26368 SOLAR-CYCLE FORECAST. Zaikov, R. G. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 24: No. 9, 1147-9(1971).

Using the empirical law of Waldmeier, a solar-cycle forecast is developed whereby two consecutive long cycles, taken in a certain sequence, form one longer cycle of 200 years. (J.C.W.)

26369 MEASUREMENT OF THE AVERAGE SOLAR NEUTRON FLUX AND ITS CORRELATION WITH SOLAR ACTIVITY. Ro, Pyung Syk. Albuquerque, N. Mex.; Univ. of New Mexico (1971). 113p. University Microfilms Order No. 72-8373.

Thesis.

Data from the University of New Mexico High Energy Neutron Detector flown on NASA satellite OSO-VI are analyzed with the aim of detecting neutrons from the Sun. The detector is a proton-recoil telescope capable of directional discrimination and responsive to neutrons of energies between 20 and 200 MeV with an effective average efficiency for this analysis of 10^{-4} and an effective area of 80 cm^2. The detector scanned the Sun once per revolution of the wheel at a rate of 30 rpm. The satellite was launched on August 9, 1969, into a circular orbit with an inclination to the equator of 33° and an altitude of 300 nautical miles. The analysis covers the period from August 14, 1969 to December 31, 1969. The instrument performed normally with the exception of gain changes in certain counters of the telescope. It was necessary to devise methods of in-flight calibration to compensate for these gain changes and maintain optimum discrimination against background. Neutron events detected while the Sun was within the forward acceptance cone of the instrument and the Earth's atmosphere was outside the cone were defined as solar neutrons for this analysis. Since very low rates were observed with no obvious sudden bursts which could be ascribed to solar-flare events, an attempt to verify the solar origin of these neutrons was made by testing for correlations with solar activity. A correlation coefficient of 0.38 ± 0.07 with the confirmed Daily Sunspot Numbers (the American Numbers) was found for events defined as solar neutrons and 0.18 ± 0.08 for nonsolar events. Correlations with other indices for solar activity and time-shifted cross correlations are also presented. (TSS) (Diss. Abstr. Int., B)

26370 ASYMMETRIES IN STRUCTURE OF FORWARD STAGNATION REGION OF THE SOLAR WIND–MAGNETOSPHERIC INTERACTION. Hirsh, Richard Stephen. Cleveland; Case Western Reserve Univ. (1971). 219p. University Microfilms Order No. 72-6304.

Thesis.

A new model of the solar wind-geomagnetic field interaction is proposed, and three distinct regions are encountered: the shock wave, the shock layer, and a diffusive sheath. The inherent asymmetry caused by the interplanetary magnetic field, a description of the flow in the stagnation region of the magnetospheric shock layer, and an examination of the diffusive magnetopause sheath are discussed and calculated. The shock-wave problem takes the form of obtaining solutions to the complete MHD oblique shock jump conditions. A comparison of gasdynamic and the MHD results shows that there is a flow deflection through the normal part of the shock. However, the maximum deflection is about the same, and the slopes of the infinitesimal waves are within ½° of each other. Hence the asymmetry seems to be concentrated in the stagnation region. It is shown for the compressible shock layer that the magnetic field is limited in strength to that on the Earth side of the magnetopause. Furthermore, the asymmetries inherited from the shock wave carry through the shock layer. On the upstream side of the magnetopause the magnetic field is essentially parallel to the ecliptic plane while on the Earth side it is nearly normal to the elliptic plane. Hence, a diffusive region is needed interior to the shock layer that will limit the tangential velocity singularity and rotate the magnetic field. Of the various mechanisms of momentum transport in a collision-free gas, it is felt that the most likely one for the magnetopause is that of particle–wave interactions. The equations for the magnetopause region including these diffusive terms then resemble MHD boundary layer equations. The boundary layer is found to be quite thick taking up about 8% of the shock-layer thickness and the stagnation point is displaced about ⅕ an Earth radius west of the Earth–Sun line. It is shown that the equations in the boundary layer are also capable of describing a layer in which the magnetic field can rotate to its value on the interior of the magnetopause. (TSS) (Diss. Abstr. Int., B)

26371 DISTRIBUTIONS OF ELECTRON PLASMA OSCILLATIONS UPSTREAM FROM THE EARTH'S BOW SHOCK. Fredricks, R. W.; Scarf, F. L.; Green, I. M. (TRW Systems Group, Redondo Beach, Calif.). J. Geophys. Res.; 77: No. 7, 1300-5 (1 Mar 1972).

Data from the 14.5- and 30-kHz plasma-wave detector channels aboard Ogo 5 for the period December 2, 1968, to April 8, 1969, demonstrate the relatively isotropic occurrence of electron plasma oscillations upstream from the bow shock. These plasma oscillations were shown previously to correlate with streams of electrons having energy >700 eV. The present study implies the presence of such streams, most probably electrons reflected by the bow shock, irrespective of spacecraft longitude in the upstream solar wind. (auth)

26372 SOLAR PARTICLES AND THE DAYSIDE LIMIT OF CLOSED FIELD LINES. McDiarmid, I. B.; Burrows, J. R.; Wilson, Margaret D. (National Research Council of Canada, Ottawa). J. Geophys. Res.; 77: No. 7, 1103-8(1 Mar 1972).

Low-altitude dayside profiles of solar-electron latitudes are examined as a function of magnetic activity. The solar-electron measurements are compared both with outer-zone electron measurements and with solar-proton measurements in an attempt to determine the dayside limit of closed geomagnetic-field lines. It is suggested that at magnetically quiet times the limit of closed field lines occurs at the position of the electron knee latitude ($\Lambda \sim 78°$) and that, as magnetic activity increases, solar electrons scatter or diffuse across closed field lines. Thus the electron knee latitude at these times lies equatorward of the high-latitude limit of closed lines. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstracts 25698, 26038, and 27285.

26373 ENERGY DISTRIBUTION OF BACKSCATTERED ELECTRONS. Arnal, F.; Verdier, P.; Vincensini, P. D. (CNRS, Toulouse). Compt. Rend., Ser. B; 273: No. 25, 1127-30 (20 Dec 1971). (In French).

The energy of electrons backscattered from targets irradiated normally with single-energy electrons was studied. The energy spectra of the backscattered electrons are obtained from a law proposed for the slowing-down process. The most probable energy and the mean energy of the spectra are in good agreement with values deduced from measurements made by other workers. (France)

26374 INFLUENCE OF O_2 ADSORPTION ON THE INTENSITY DISTRIBUTION OF ELECTRONS SCATTERED FROM W (100). Edwards, David Jr.; Propst, F. M. (Univ. of Illinois, Urbana). J. Chem. Phys.; 56: No. 6, 3184-5(15 Mar 1972).

The intensity distribution of electrons scattered by the (100) surface of W exposed to O_2 for various lengths of time was measured. The incident electrons had energies of 0 to 40 eV, and measurements were made at two azimuthal angles, 0 and 45°. It was found that the structures at 3.0 and 4.3 eV present in the scattering by clean W at 0° decrease quickly during the first 5 s of exposure to 0_2, leaving the remaining structure relatively unaffected. Saturation occurs at about 30 s of exposure. Possible explanations in terms of the adsorption process are considered briefly. (A.G.W.)

26375 SCATTERING OF HELIUM, NEON, ARGON, KRYPTON, XENON, AND DEUTERIUM FROM A TUNGSTEN (110) SURFACE CHARACTERIZED BY LEED. Weinberg, W. H.; Merrill, R. P. (Univ. of California, Berkeley). J. Chem. Phys.; 56: No. 6, 2881-92(15 Mar 1972).

Rare gas (He, Ne, Ar, Kr, and Xe) scattering distributions were measured from a tungsten (110) surface at an incidence angle of 45°. The gas temperature was 295°K, while the surface temperature varied between 375 and 1300°K. The positions of the peak maxima and the broadening of pseudospecular scattering of He and Ne correlate with the FRI models, whereas the Ar–Xe results are anomalous in that these aspects of the scattering do not correlate with either the FRI or soft-cube models because Ar, Kr, and Xe are dominated by trapping at the surface. An estimate of the fraction of the rare gas atoms initially trapped at the surface was made. Deuterium scattering distributions were measured and are characterized by a relatively large diffuse fraction, which is attributed to an internal excitation of the diatomic molecule rather than to trapping at the metal surface. Comparisons of these data with scattering from the (111) face of fcc crystals suggests three phenomenologically distinguishable scattering regimes, quasi-elastic, inelastic, and trapping dominated scattering. (auth)

26376 ATOMIC AND MOLECULAR DIFFRACTION AND SCATTERING FROM A TUNGSTEN CARBIDE SURFACE CHARACTERIZED BY LEED. Weinberg, W. H.; Merrill, R. P. (Univ. of California, Berkeley). J. Chem. Phys.; 56: No. 6, 2893-2902 (15 Mar 1972).

The scattering of collimated beams of helium, deuterium, neon, and argon is reported from two tungsten carbide surfaces that form on the (110) face of tungsten. On a (3 × 5) surface both helium and deuterium give sharp, well-defined diffraction peaks corresponding to the $(\bar{2}, 0)$, $(\bar{1}, 0)$, (0, 0), (1, 0), (2, 0) directions along the 5 spacing. No diffraction is observed on the (1 × 1) carbide surface or the clean metal surface, which is also (1 × 1). Fractions scattered in the specular ray, (0, 0), as high as 55% were observed from the carbide surfaces. The scattering of neon is in the inelastic regime and argon is trapping-dominated. Analysis of the scattering in combination with the LEED suggests a dense carbide, perhaps WC, with a Debye temperature of 1200°K or higher. This diffractive scattering is the first reported on a surface other than alkali halides and some comments on the sort of periodic potential likely to give rise to diffractive scattering of atoms are given. (auth)

26377 TEMPERATURE DEPENDENCE OF THE SPUTTERING OF A SILVER SINGLE CRYSTAL. Bhattacharya, R. S.; Mukherjee, D. K.; Karmohapatro, S. B. (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Instrum. Methods; 99: No. 3, 509-10(1972).

Sputtering yield of a silver single crystal bombarded by 6-keV neon and krypton ions was measured for targets at varying temperatures in the range 200 to 600°C. Results show no variation in the sputtering yield. (1 figure) (auth)

26378 STUDY OF THE OPTIMIZATION OF ION SOURCES WITH OSCILLATING ELECTRONS. Grigorov, G. I. (Inst. of Electronics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 24: No. 5, 581-4(1971).

The ionizing system with electrons oscillating in a magnetic field, which forms the basis of the sources discussed, consists of a hot (or cold) cathode, a ring-like or cylindrical anode in front of the cathode and a reflecting electrode located at distance L from the cathode and with a potential equal or inferior to that of the cathode. The effectiveness of the ion source depends upon the degree of interaction (and consequent ionization) between the electron beam and the plasma produced. The dependence of the degree of ionization on the pressure in the ion source and on the length of the interaction L was studied, and the results are shown in figures. (3 figures) (A.G.W.)

Atomic and Molecular Properties

Refer also to abstracts 26449, 26470, 26786, 26788, and 27310.

26379 ISOTOPE SHIFTS IN THE SPECTRA OF Dy I AND Er I. Ross, John S. (Rollins Coll., Winter Park, Fla.). J. Opt. Soc. Amer.; 62: No. 4, 548-54(Apr 1972).

Atomic isotope shifts in the visible region of the spectra of dysprosium and erbium were measured using separated isotopes and a Fabry–Perot interferometer. Results include data on 165 lines for the shift $\Delta\nu(164-160)$ in Dy I and on 146 lines for the shift $\Delta\nu(170-166)$ of Er I. Isotope shifts for 68 low-lying odd levels of dysprosium were obtained relative to the ^5I term of the $4f^{10}6s^2$ configuration. In the spectra of both dysprosium and erbium it was determined that $f^{n-1}ds^2$–f^ns^2 transitions exhibit positive isotope shifts and f^nsp–f^ns^2 transitions have negative isotope shifts. The observed isotope shifts in certain low-lying $4f^{12}6s6p$ levels of erbium indicate strong configuration interaction. (auth)

26380 FOURTH SPECTRUM OF LUTETIUM. Sugar, Jack; Kaufman, Victor (National Bureau of Standards, Washington, D. C.). J. Opt. Soc. Amer.; 62: No. 4, 562-70(Apr 1972).

Spectra of lutetium obtained with a sliding spark were photographed in the wavelength range 400 to 3200 Å. Wavelengths of 246 lines, comprising all lines identified as Lu IV appearing in the spark at 50-A peak current, are given. Fifty-seven energy levels were deduced from these lines, including nearly all levels of the $4f^{13}$(5d, 6s, 6p, 6d, and 7s) configurations and their connection to the $4f^{14}\ ^1S_0$ ground state. An ionization energy of 364,500 ± 200 cm^{-1} was derived. The energy levels are interpreted by means of a theoretical analysis utilizing fitted radial parameters. With these results, trends of Slater and spin–orbit parameters and configuration energy differences for fourth spectra of the rare earths are found. The fundamental energy differences between lowest levels of the $4f^N$ and $4f^{N-1}5d$ configurations for the fourth and fifth spectra are deduced. (auth)

26381 CONFIGURATIONS $4f^{10}6s6p$ AND $4f^95d6s^2$ IN NEUTRAL DYSPROSIUM. Griffin, Donald C. (Rollins Coll., Winter Park, Fla.); Ross, John S.; Cowan, Robert D. J. Opt. Soc. Amer.; 62: No. 4, 571-9(Apr 1972).

A partial analysis of the configurations $4f^{10}6s6p$ and $4f^95d6s^2$ in neutral dysprosium was based on least-squares calculations of energy-level structures, combined with experimental data for observed energy levels, g values, and isotope shifts. Thirty-one levels for each configuration have now been interpreted; of these, 24 levels are new designations in $4f^{10}6s6p$ and 18 are new designations in $4f^95d6s^2$. The levels of $4f^{10}6s6p$ were fitted to within a standard deviation equal to 0.6% of the experimental energy-level spread, and the levels of $4f^95d6s^2$ to within 0.9%. The agreement between experimental and calculated g values is good and the configuration assignments are consistent with isotope-shift data. (auth)

26382 ATOMIC AND IONIC RADII OF SUPERHEAVY ELEMENTS. Fricke, B.; Waber, J. T. (Northwestern Univ., Evanston, Ill.). J. Chem. Phys.; 56: No. 7, 3246-9(1 Apr 1972).

Atomic and ionic radii are presented for the elements E104 to E120 and E156 to E172. It is shown that effects correlated with the large relativistic contraction of orbitals with low angular momentum lead to smaller atoms for higher atomic numbers. It is expected that Cs is the largest atom in nature. (auth)

26383 USE OF THE NONSYMMETRICAL WAVE FUNCTION. III. MAGNETIC SUSCEPTIBILITY OF MOLECULAR HYDROGEN. Saika, A. (Yeshiva Univ., New York); Musher, Jeremy I.; Miyabe, Nobuaki. J. Chem. Phys.; 56: No. 7, 3312-5(1 Apr 1972).

The nonsymmetrical (NS) wave function is used to calculate the magnetic susceptibility of the hydrogen molecule. Triple perturbation theory with the aid of the interchange theorem allows one to calculate the susceptibility through first order in electron correlation and it is found that the NS function yields reasonable results. (auth)

26384 ATOMIC GROUND-STATE CONFIGURATIONS OF THE ELEMENTS E159 AND E160. Fricke, B.; Waber, J. T. (Northwestern Univ., Evanston, Ill.). J. Chem. Phys.; 56: No. 7, 3726-7(1 Apr 1972).

A series of Dirac–Slater self-consistent-field calculations was used to determine the total energy of elements 159 and 160. The results indicate unexpected ground-state configurations for the elements. The valence electrons are expected to be $7d^{4}9s^{1}$ for element 159 and $7d^{5}9s^{1}$ for element 160, rather than the continuous filling of the d shell expected earlier. (A.G.W.)

26385 MEASUREMENT OF DIFFERENTIAL SCATTERING CROSS SECTIONS OF MOLECULAR HYDROGEN AT 5.41 keV. Aman, Richard Wesley. Eugene, Oreg.; Univ. of Oregon (1971). 80p. University Microfilms Order No. 72-8508.

Thesis.

Absolute measurements of the differential scattering cross section of molecular hydrogen were made at 60, 90, and 135° for 5.41-keV Cr Kα x rays. A well-collimated beam of $\sim 4 \times 10^{6}$ photons/s from a commercial x-ray tube was monochromatized through a LiF single-crystal spectrometer. The scattering gas was contained in a specially designed, 15-cm-dia stainless-steel scattering chamber equipped with dished 0.013-cm-thick beryllium windows. The scattered radiation was detected with a xenon-filled proportional counter. The scattering volume was defined by baffles that limited the solid angle subtended by the counter. To determine the primary-beam intensity, the x rays were attenuated with calibrated vanadium absorber foils and monitored with a second proportional counter. Measured cross sections were found to be independent of scattering-gas pressure from 1610 to 4060 torr, which proves that intermolecular effects were negligible. The differential scattering (collision) cross section for 5.41-keV x-rays in H_2 gas was found to be 95.5 ± 4.8 mb/s at 60°, 64.6 ± 3.2 mb/s at 90°, and 97.5 ± 4.9 mb/s at 135°. Theoretical predictions for these cross sections, based on the Waller–Hartree derivation and on calculations by Kilby, are 116.6 mb/s at 60°, 81.3 mb/s at 90°, and 116.7 mb/s at 135°. (Diss. Abstr. Int., B)

26386 ^{1}P AUTOIONIZATION STATES OF He IN THE ELASTIC SCATTERING REGION. Chung, Kwong T.; Chen, I-hsiun (North Carolina State Univ., Raleigh). Phys. Rev. Lett.; 28: No. 13, 783-6(27 Mar 1972).

Higher members of ^{1}P autoionization states of He are calculated in the elastic scattering region and compared with experiments. The third resonance series was previously believed to be absent from the observed spectrum of Madden and Codling. In the present work it is found that these energy levels lie very close to some other states that were identified. By calculating the oscillator strength, it is found that these "missing states" contribute significantly to the observed line intensity. (auth)

26387 ATOMIC STRUCTURE CALCULATIONS FOR Tm^{2+} AND Tm^{3+}. Damommio, Anthony Vinson. Fort Worth, Tex.; Texas Christian Univ. (1971). 188p. University Microfilms Order No. 72-7620.

Thesis.

The self-consistent field (SCF) expansion method was employed to calculate accurate analytical SCF wave functions for the ground states of the ground configurations of two laser-active ions, Tm^{2+}, $4f^{13}$, ^{2}F and Tm^{3+}, $4f^{12}$, ^{3}H, (Z = 69). Calculations were also performed for the ^{3}H-ground state of the excited configuration $4d^{9}4f^{13}$ of Tm^{3+}. An amended computer program was used to accommodate atomic systems with 4f orbitals. All of the basis function exponents were optimized carefully and repeatedly. Convergent SCF results were obtained for the six excited states of the ground configuration $4f^{12}$ and for seven excited states of the excited configuration $4d^{9}4f^{13}$ of Tm^{3+}. The calculated orbital wave functions for both ions are available for the first time. The analytical SCF wave functions for Tm^{2+} and Tm^{3+} were utilized to compute the free-ion energy levels of these two ions, without using any empirical or semi-empirical parameters. In these calculations energy matrices, which include the electrostatic, spin–orbit, orbit–orbit and spin–other-orbit interactions, were constructed and diagonalized. Spin–orbit coupling constants for Tm^{2+} and Tm^{3+} are presented. The free-ion energy-level assignments are compared with experimental data extrapolated from solution and crystal spectra. (Diss. Abstr. Int., B)

26388 FINE STRUCTURE OF $H_2(d\ ^{3}\Pi_u)$ BY MICROWAVE OPTICAL MAGNETIC RESONANCE INDUCED BY ELECTRONS. Miller, Terry A.; Freund, Robert S. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys.; 56: No. 6, 3165-6 (15 Mar 1972).

A measurement of the fine structure of $H_2(d\ ^{3}\Pi_u)$ is described briefly. The observed resonance positions are listed and compared with predicted positions. Agreement is within experimental error. (A.G.W.)

26389 ANALYTICAL SELF-CONSISTENT-FIELD ENERGY EXPRESSION FOR GROUND-STATE H_3^+ ION. Huang, Jan-tsyu J. (Univ. of Notre Dame, Ind.). J. Chem. Phys.; 56: No. 6, 3176-7(15 Mar 1972).

An approximate expression for the energy of ground-state H_3^+ is based on a combination of the energies of H_2, H_2^+, and H. Energies calculated from this expression for various internuclear distances (R) are shown; agreement with more accurate self-consistent-field calculations is fairly good. A minimum energy of −1.314 au at R = 1.70 au was found. (A.G.W.)

26390 DIRECT MEASUREMENT OF THE PHOTOELECTRIC CROSS SECTION OF MOLECULAR HYDROGEN AT 5.41 AND 8.39 keV. Koblas, Paul Everett. Eugene, Oreg.; Univ. of Oregon (1971). 78p. University Microfilms Order No. 72-8560.

Thesis.

A new technique was developed for the direct measurement of the photoelectric cross section. An intense, nearly monochromatic x-ray beam traverses a large, specially-designed, hydrogen-filled proportional counter. Photoelectrons produced in the hydrogen are given to a wire anode and, through gas multiplication, produce a pulse that is amplified and analyzed. Energy discrimination excludes Compton electrons from being counted. A grid retards photoelectrons that may be ejected from the counter walls by scattered photons. Field tubes maintain a strictly radial electric field, preventing end effects and clearly defining the sensitive volume. Experiments were performed with a beam of $\sim 10^{6}$ photons/s from commercial Cr and W x/ray tubes, monochromatized through a LiF-crystal spectrometer. To monitor the beam intensity, fluorescent radiation from thin Ti and Ni foils in the emergent beam was counted with a Xe proportional counter. The counting chamber was filled with exceedingly pure hydrogen from a Pd–Ag alloy diffusion purifier. The probability per unit pressure of creating a photoelectron was found to be independent of pressure over the range from 300 to 1500 torr, indicating that losses from electron attachment were negligible. The photoelectric cross section of molecular hydrogen at 5.41 keV was found to be 60 ± 3 mb per atom. At 8.39 keV, the cross section was measured as 12.0 ± 0.6 mb per atom. These cross sections exceed by a factor of ~1.5 the predictions for single hydrogen atoms, derived from nonrelativistic wave functions. (Diss. Abstr. Int., B)

26391 ANALYTICAL WAVE FUNCTIONS AND OSCILLATOR STRENGTHS FOR Ce^{3+}, Pr^{3+}, Nd^{3+}, AND Cu^{2+}. Grossgut, Paul John. Fort Worth, Tex.; Texas Christian Univ. (1971). 174p. University Microfilms Order No. 72-7621.

Thesis.

Accurate analytical self-consistent-field (SCF) wave functions are presented for the ground state and some excited states of Ce^{3+} (Z = 58), Pr^{3+} (Z = 59), and Nd^{3+} (Z = 60). The accurate results for the excited states are available for the first time. The wave functions for these ions were used to compute the total weighted electric-dipole oscillator strength $g_i f$ for optical transitions between various states of these ions. The oscillator strengths were calculated so as to include the entire relaxation effect of the charge cloud. It is expected that these results will be helpful in the specification of the intensities of the lines present in the free-ion spectra of the above lanthanides. It was found that the formulas for the relative line and multiplet strengths, as derived by use of Racah's algebra of tensor operators, apply rigorously even when one includes the relaxation effect due to the overlap between the transiting and nontransiting electrons. To test the results for oscillator strengths, the analytical SCF procedure was also employed in the calculation of the wave functions and energies for

the 1s, 2p, and 3p hole states of Cu^+ (Z = 29); the resulting wave functions were applied in a theoretical determination of the K_α/K_β x-ray intensity ratio in Cu^{2+}; very good agreement with experiment was obtained. (Diss. Abstr. Int., B)

26392 LAMB SHIFT CORRECTION AND ENERGY LEVEL SHIFT IN MUONIC ATOMS VIA ρ^0 MODIFIED PHOTON PROPAGATOR. Buchl, R. A.; Nigam, B. P. (Arizona State Univ., Tempe). Particles Nucl.; 3: No. 1, 40-5(Jan 1972).

The modified photon propagator derived from ρ^0 meson insertions is used to derive a modified Coulomb law from which the correction to the Lamb shift is estimated for hydrogen. The proton is taken in this calculation and with nonrelativistic wave functions for the hydrogen atom, the resulting shift is seen to be very much smaller than current experimental accuracy. The modified photon propagator is also used to find the energy level shift in muonic atoms. (auth)

26393 L-SHELL PHOTOELECTRIC CROSS-SECTIONS FOR HEAVY ATOMS AT 145 AND 279 keV. Singh, M. I.; Sood, B. S. (Punjabi Univ., Patiala, India). Nuovo Cim.; 8B: No. 1, 261-70 (11 Mar 1972).

L-shell photoelectric cross sections for mercury, gold, thallium, lead, bismuth, thorium, and uranium at 145 and 279 keV energies have been determined via two methods. The technique employed here involves measurement of the total intensity of fluorescent L x rays that follow the photoelectric absorption of a known flux of γ rays in the L shell. A proportional counter was used as a fluorescent L x-ray detector. The results are in good agreement with the theoretical predictions of Schmickley and Pratt. (auth)

26394 EFFECT OF A CONSTANT ELECTRIC FIELD ON MULTIPHOTON IONIZATION. Nikishov, A. I. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 62: No. 2, 562-8 (Feb 1972). (In Russian).

Differential probabilities for detachment of an electron bound by short-range forces (e.g., in H^-) by a varying electric field with a constant component are obtained. In the most interesting case of a weak wave field the presence of a constant field considerably increases the detachment probability, providing the field strength is sufficient for efficient opening of the nearest subthreshold (with respect to number of quanta absorbed from the wave) channels. (auth)

26395 PRECISION ATOMIC BINDING ENERGIES. Burr, A. F. (New Mexico State Univ., Las Cruces). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 259-63(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

A very brief summary of the method for obtaining atomic binding energies for occupied energy levels by means of x-ray line excitation curves is given with some results of measurements performed on cobalt, nickel, lanthanum, and cerium. A very condensed description of a method for using $L_{II} - L_{III}$ binding-energy differences to obtain an estimate of the Lamb shift for heavy elements is also given. (auth)

26396 FINE AND HYPERFINE STRUCTURES OF ATOMIC HYDROGEN. Ramsey, Norman F. (Harvard Univ., Cambridge, Mass.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 317-20 (Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The fine and hyperfine structures of the atomic hydrogen spectrum have been particularly fruitful sources of new developments in physics, and the precise measurements of these structures have provided accurate checks on quantum electrodynamics and atomic theory. During the past few years there have been new measurements and new theoretical calculations of the fine and hyperfine structures of atomic hydrogen. These new measurements and theories have removed most of the discrepancies that previously existed between experiment and theory and there is now remarkable agreement between experiment and theory. (54 references) (auth)

26397 PRESSURE SHIFTS OF HYPERFINE FREQUENCIES IN ONE-ELECTRON ATOMS. Ensberg, E. S.; Morgan, C. L. (Yale Univ., New Haven). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 321-5(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Optical pumping methods for hydrogen in argon yield a pressure shift of the hydrogen hyperfine splitting $(1/\nu_0)(\partial\nu_0/\partial\rho)$, which varies linearly with argon temperature (at constant density ρ) from 5 to 60°C and becomes less negative with increasing temperature by the amount of (0.20 ± 0.01) percent/degree C for hydrogen and tritium. The fractional pressure shifts for these two isotopes are $(-4.803 \pm 0.015) \times 10^{-9}$/torr(0°C) at about 26°C. Work continues on deuterium. The result for H and T suggests that the pressure shift of muonium hyperfine splitting should agree with hydrogen to within a few percent. (auth)

26398 DETERMINATION OF THE ATOMIC HYDROGEN FINE STRUCTURE BY LEVEL CROSSING IN THE 2P STATES OF HYDROGEN: A MEASUREMENT OF THE FINE STRUCTURE CONSTANT. Baird, J. C.; Brandenberger, John; Gondaira, Kenichiro; Metcalf, Harold (Brown Univ., Providence). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 345-53(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The Sommerfeld fine-structure constant α was measured by level-crossing spectroscopy in atomic hydrogen. The result is $\alpha^{-1} = 137.0354(6)$ where the (6) is the combined statistical and experimental uncertainty and represents a 70% confidence level. Experimental and theoretical considerations are presented in the light of contributions to systematic errors that might shift the resultant value of α. (auth)

26399 MEASUREMENT OF THE $2^2S_{\frac{1}{2}} - 2^2P_{\frac{1}{2}}$ ENERGY SEPARATION, $(\Delta E - \mathscr{J})$, IN HYDROGEN (n = 2). Shyn, Tong Wha; Robiscoe, R. T.; Williams, W. L. (Univ. of Michigan, Ann Arbor). Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 355-60(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The $2S_{\frac{1}{2}} - 2P_{\frac{1}{2}}$ energy separation, $(\Delta E - \mathscr{J})$, in the n = 2 state of atomic hydrogen was measured by an atomic-beam radiofrequency method. A beam of metastable atoms in the single hyperfine state $\beta_A(F, m_F = 0, 0)$ was used. The electric dipole transitions $\beta_A - b(F, m_F = 1, +1)$ and $\beta_A - d(F, m_F = 1, -1)$ were observed at fixed frequencies by sweeping the Zeeman magnetic field parallel to the beam axis. The final value of the $(\Delta E - \mathscr{J})$ is 9911.250 ± 0.063 MHz where the quoted uncertainty is one average deviation from the mean. Using the revised experimental value of the Lamb shift, $\mathscr{J}_H = 1057.90 \pm 0.10$ MHz, one obtains $\Delta E = (10969.15 \pm 0.12)$ MHz. The corresponding value for α^{-1} is 137.0356 ± 0.0007. (auth)

26400 MEASUREMENT OF $\Delta E - \mathscr{J}$ IN H AND A CORRECTION TO THE MEASURED VALUE OF $\mathscr{J}$ IN D. Vorburger, T. V.; Cosens, B. L. (Yale Univ., New Haven). Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 361-5(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The $2^2S_{\frac{1}{2}} - 2^2P_{\frac{1}{2}}$ separation $\Delta E - \mathscr{J}$ in hydrogen was measured by a microwave atomic-beam technique. The result obtained from four independent transitions is $\Delta E - \mathscr{J} = 9911.173 \pm 0.042$ MHz. This result is combined with the recent determination of the Lamb shift $\mathscr{J}$ by Robiscoe to obtain a value for the fine structure splitting ΔE and a value for the fine structure constant $\alpha^{-1} = 137.0358(5)$. Also a correction in a previous measurement of the Lamb shift $\mathscr{J}$ in D resulting from a beam velocity distribution measurement recently made by Robiscoe and Shyn is reported. The corrected value is 1059.28 ± .06 MHz. (auth)

26401 MEASUREMENT OF THE $2^2S_{\frac{1}{2}} - 2^2P_{\frac{1}{2}}$ INTERVAL IN ATOMIC HYDROGEN. Kaufman, S. L.; Lamb, W. E., Jr.; Lea, K. R.; Leventhal, M. (Yale Univ., New Haven). Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 367-71(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The interval $2^2S_{\frac{1}{2}} - 2^2P_{\frac{1}{2}}$ in hydrogen, denoted $(\Delta E - \mathscr{J})_H$, was determined through measurements on the two transitions αa $(M_J = +\frac{1}{2} \rightarrow +\frac{3}{2})$ and αb $(M_J = +\frac{1}{2} \rightarrow +\frac{1}{2})$. Details of the microwave–optical experiment are described. The line shape theory is briefly discussed, and the data are summarized. An outline of the treatment of several small corrections is included. The weighted average gives $(\Delta E - \mathscr{J})_H = 9911.377 \pm 0.026$ MHz. This is compared with a recent theoretical result. (auth)

26402 ATOMIC BEAMS MEASUREMENTS OF THE FINE STRUCTURE OF H, n = 2. Robiscoe, R. T. (Montana State Univ., Bozeman). Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 373-6(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The most recent experimental systematic corrections to atomic-beam measurements of the fine structure of the first excited state of atomic hydrogen are discussed; particular attention is given to those measurements of the Lamb shift S with a claimed accuracy of 0.1 MHz. The newest correction has to do with kinematic effects on the beam velocity distribution. When this correction is applied

to the so-called level-crossing experiments, the best expurgated value of S is found to be 1057.90 ± 0.10 MHz. This result is compared with the most recent theoretical value, and its reliability is considered. (auth)

26403 SEPARATED OSCILLATORY FIELD MEASUREMENT OF THE LAMB SHIFT. Fabjan, C. W.; Pipkin, F. M. (Harvard Univ., Cambridge, Mass.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 377-81(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

A new technique of observing the Lamb shift, which combines beam–foil and radio-frequency spectroscopy techniques, is described. Measurements are made on fast H atoms in zero magnetic field by sweeping the frequency of the rf field. It is described how this technique allows the use of Ramsey-separated oscillatory rf fields with a resulting decrease in the observed line width of the resonance. A rf hyperfine state selector is used to reduce the effect of overlapping lines. (auth)

26404 MEASUREMENT OF THE LAMB SHIFT IN THE n = 4 STATE OF HYDROGEN. Brown, R. A.; Pipkin, F. M. (Harvard Univ., Cambridge, Mass.). Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 383-8(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Progress on a study of the fine structure in the n = 4 state of atomic hydrogen is reported. Measurements are made as a function of the external magnetic field with a fixed radio-frequency field. A pulsed electron beam is used to excite the atoms, and the signals are observed in a selected time interval following the excitation pulse. Observations are reported on transitions in both the $4S_{\frac{1}{2}} \rightarrow 4P_{\frac{1}{2}}$ and the $4S_{\frac{1}{2}} \rightarrow 4P_{\frac{3}{2}}$ complexes. (auth)

26405 DETERMINATION OF THE FINE STRUCTURE CONSTANT α FROM HELIUM FINE STRUCTURE. Kponou, A.; Hughes, V. W.; Johnson, C. E.; Lewis, S. A.; Pichanick, F. M. J. (Yale Univ., New Haven). Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 389-91(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

A measurement of ν_{01}, the interval between the components J = 0 and J = 1 of the fine structure in the 2^3P state of helium, was made by an optical–microwave atomic-beam magnetic-resonance technique. The result is ν_{01}(expt.) = 29,616.864 ± 0.036 MHz (±1.2 ppM). The (one standard deviation) error is determined primarily by the statistical counting error. This result is 3.09 MHz smaller than the present theoretical value. This difference is presumably due to an uncalculated theoretical term of $O(\alpha^4 Ry)$. When this latter calculation is completed it should be possible to determine α to 1 ppM. (auth)

26406 PRECISION MEASUREMENT OF THE LAMB SHIFT IN SINGLY IONIZED HELIUM. Narasimham, Musti A. (National Bureau of Standards, Boulder, Colo. Univ. of Colorado, Boulder); Strombotne, R. L. Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 393-402(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The Lamb shift (S) in the n = 2 level of singly ionized helium was measured by using a microwave method. The experiment was performed in an applied homogeneous magnetic field at three different operating values for the helium pressure, and the result is extrapolated to a zero pressure value. A search was made for all possible systematic errors in the experiment. The result for S thus obtained is 14046.2 ± 2.0 MHz. This result agrees with the previous experimental values (within three standard deviations) and the theoretical value of 14044.5 ± 5.2 MHz. (auth)

26407 PRECISION MEASUREMENT OF THE FINE STRUCTURE AND LIFETIMES OF THE $(1s2s2p)\,^4P_J$ STATES OF He^- AND Li*. Novick, Robert; Weinflash, David (Columbia Univ., New York). Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 403-10 (Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

A series of measurements was completed and others are in progress for the precise determination of the energies and lifetimes of the metastable autoionizing $(1s2s2p)\,^4P_J$ states in He^- and Li*. Since these states have lifetimes in the range from 5 to 500 μs and since the fine and hyperfine structure intervals are of the order of a wave number, it will be possible to determine the splitting with a relative accuracy of one part in 10^6 or better. Present measurements in ^{6}Li and ^{7}Li are at the level of one part in 10^4 and a preliminary crude estimate was made of the $^4P_{\frac{3}{2}}$–$^4P_{\frac{5}{2}}$ interval in He^-. Further work is in progress with radio-frequency techniques to obtain very much more precise results. Considerable theoretical effort must be made before these results can be interpreted in terms of fundamental constants. However, it is clear that if the necessary numerical wave functions can be obtained with sufficient accuracy and if the various radiative and relativistic corrections can be evaluated, then these results will provide a precise new independent value for the Sommerfeld fine structure constant. (auth)

26408 $1S_{\frac{1}{2}}$ BOUND-STATE CORRECTIONS TO THE ELECTRON AND PROTON g FACTORS FOR ATOMIC HYDROGEN. Hegstrom, Roger A. (Wake Forest Univ., Winston-Salem, N. C.) Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 417-20(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Bound-state corrections of orders α^2, α^3, $\alpha^2 m/M$, and higher are calculated for the electron and proton g factors in atomic hydrogen. The method of calculation involves finding a set of mutually commuting operators including the Breit Hamiltonian, partially separating the usual center-of-mass coordinates by choosing the wave function to be a simultaneous eigenfunction of these operators performing a Foldy–Wouthuysen transformation of the resulting simplified Breit equation, and using first-order perturbation theory with the nonrelativistic Pauli–Schrödinger eigenfunction as the zero-order wave function to obtain the g factors. Results are also applied to deuterium, and comparisons are made with experiments and with earlier theoretical results. (auth)

26409 ELECTROMAGNETIC INTERACTIONS OF HYDROGENIC ATOMS: CORRECTIONS TO g FACTORS. Grotch, Howard (Pennsylvania State Univ., University Park). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 421-5(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Corrections to g factors in hydrogenic atoms are obtained from the Breit equation. Explicit wave functions for a slowly moving atom are obtained in the absence of external fields. Interaction with a constant magnetic field is treated perturbatively to obtain bound-state corrections to g factors arising from relativistic effects and from nuclear motion. Another method involving a unitary transformation is also discussed. The advantage of this approach is that for a neutral system the unperturbed wave functions are given in the rest frame. Results are compared with experiment, in particular the ratio of $g_e(H)/g_e(D)$. (auth)

26410 RATIO OF ATOMIC g_J VALUES FOR HYDROGEN AND DEUTERIUM: AN ISOTOPE EFFECT. Robinson, H. G.; Hughes, William M. (Duke Univ., Durham, N. C.). Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 427-30(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

An experimental determination of the $g_J(H)/g_J(D)$ ratio is reviewed. Optical pumping with electron spin-exchange detection of H and D Zeeman resonances was used. The applied magnetic field was ~50 G. A discussion of various possible sources of systematic error is given. Recent work indicates that the previous estimate of possible systematic error was too large. The result without estimate of systematic error is $g_J(H)/g_J(D) = 1 + (7.2 \pm 1.2) \times 10^{-9}$. This is compared with theory. (auth)

Positronium, Muonium, and Mesic Atoms and Molecules

Refer also to abstracts 26392, 26397, 26481, 26482, 27299, 27300, and 27301.

26411 ANGULAR CORRELATION OF ANNIHILATION PHOTONS IN FROZEN AQUEOUS SOLUTIONS. Milosevic-Kvajic, M.; Mogensen, O.; Kvajic, G.; Eldrup, M. (Danish Atomic Energy Commission, Risoe). J. Chem. Phys.; 56: No. 6, 2567-71 (15 Mar 1972).

Linear-slit angular correlation curves were obtained at about −140°C for frozen aqueous solutions of HF, HCl, HBr, HI, NH_3, $FeCl_2$, $FeCl_3$, NaI, H_2SO_4, HNO_3, $MnSO_4$, $KMnO_4$, $K_2Cr_2O_7$, NaOH, and LiOH. We found no appreciable influence of a 4% concentration of the last seven impurities. Only halide-containing impurities strongly changed the form of the curves; ppM concentrations of HCl and HF could be seen. The main change was a broadening of the part of the curve where the narrow and broad components meet. This fact is interpreted as being caused by trapping of para-positronium in holes in the structure created by the impurities. No evidence of any chemical reactions of positronium and the im-

purities was found. The annealing of a fast-frozen $FeCl_2$ solution was studied. The strongest changes in the curves occurred on annealing from −136 to −100°C. (auth)

26412 PROBLEMS OF INTERPRETATION OF K MESIC ATOMS. Bugg, W. M. (Univ. of Tennessee, Knoxville); Condo, G. T.; Hart, E. L.; Cohn, H. O.; McColloch, R. D. Particles Nucl.; 2: No. 4, 201-6(Oct 1971).

It is shown that the value of the principal quantum number from which K^- mesons are captured has not reliably been determined. It is also pointed out that the original emulsion data suggesting a neutron halo in heavy nuclei carries implications regarding pion reabsorption that are not understood. (auth)

26413 POSITRON ANNIHILATION EXPERIMENT FOR DETERMINING THE FINE-STRUCTURE CONSTANT. Sauder, William C. (National Bureau of Standards, Washington, D. C.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 275-8(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

A measurement of the Compton wavelength to one part per million determines the value of α to one-half part per million. In this experiment, the Compton wavelength is determined by measuring the wavelength of the gamma radiation produced in two-photon annihilation of positronium. A Bragg-angle measurement to one ppM will be carried out with a two-crystal Laue transmission spectrometer capable of angular measurements accurate to 10^{-3} arc seconds. The annihilation line will be narrowed by allowing the positronium decay to occur in low-temperature helium gas in the presence of a magnetic field. (auth)

26414 THEORY OF THE POSITRONIUM HYPERFINE STRUCTURE. Fulton, Thomas; Owen, David A.; Repko, Wayne W. (Johns Hopkins Univ., Baltimore). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 309-12(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

A calculation of the $m\alpha^6 \ln\alpha^{-1}$ contributions to the triplet–singlet splitting of the positronium ground state (the positronium "hyperfine" structure) is presented. The result $\Delta\nu(\alpha^6 \ln\alpha^{-1}) = \frac{3}{4}\alpha R_\infty \ln\alpha^{-1} = 34$ MHz, places the theoretical value for the transition frequency ν approximately one standard deviation above the experimental value. The calculation is performed using a perturbation theory based on the Bethe–Salpeter equation and a wave function obtained by a single iteration from the nonrelativistic Pauli wave function. (auth)

26415 PRECISION MEASUREMENT OF THE FINE STRUCTURE INTERVAL OF THE GROUND STATE OF POSITRONIUM. Carlson, E. R.; Hughes, V. W.; Theriot, E. D. Jr. (Yale Univ., New Haven). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 313-16(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

An experiment is in progress to improve the accuracy of the determination of the fine-structure interval of the ground state of positronium to about 10 ppM from its present level of 59 ppM. The present status of this experiment is discussed. An accuracy of 10 ppM will provide a sensitive test of the $\alpha^4 Ry \ln\alpha^{-1}$ term in the theoretical fine-structure interval and will necessitate a calculation of the terms of order $\alpha^4 Ry$. (auth)

26416 HYPERFINE STRUCTURE INTERVAL OF THE GROUND STATE OF MUONIUM. Thompson, P. A.; Casperson, D.; Crane, P.; (and others) (Yale Univ., New Haven). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 339-43(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The results of the most recent very weak field determinations of the muonium hyperfine structure are reported. Combined with the older data they give a value of $\Delta\nu = 4463.308 \pm 0.013$ MHz (±2.9 ppM). The first strong evidence for a nonlinear term in the fractional pressure shift of muonium is presented. (auth)

Collision Phenomena

Refer also to abstract 26385.

26417 (CEA-N-1511) THREE BODY PROBLEM AND THE OPTICAL POTENTIAL APPLIED TO LOW ENERGY e-H SCATTERING. Decoster, A.; Fabre, B. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). 29 Jun 1971. 78p. (In French). Dep. NTIS (U. S. Sales Only).

Low-energy scattering (nonrelativistic) of charged particles by H atoms is studied. A simple potential (preferably central) is used to describe the process. Variational methods and the optical-model theory are used. The optical model indicates that the phenomenon may be represented exactly by a potential. The wave function of an atom adiabatically perturbed by the external charge may be calculated analytically in the first order and numerically for all the perturbation orders. The employment of these test functions in a variational framework leads to approximations for the optical potential, which can include all the adiabatic and non-adiabatic effects in the first order. The various potentials obtained are compared, and the results of calculations of the phase shift and of formation of H^- are presented as tests of their accuracy. (38 references) (France)

26418 (JUL-799-NP) COLLISION PARAMETER DEPENDENCE OF THE L-SHELL IONIZATION OF IODINE AND TELLURIUM ON BOMBARDMENT OF THIN Te TARGETS WITH 18 TO 46 MeV I IONS. Stein, H.-J. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Neutronenphysik). Sep 1971. 62p. (In German). Dep. NTIS (U. S. Sales Only).

Emission of L x rays in collisions of the almost-identical partners iodine–tellurium was measured at collision energies of 18.6, 30.8, and 46.0 MeV (laboratory energy). From the data, collision parameter dependence was computed for the L-shell ionization of iodine and tellurium, respectively. The total cross section for L-shell ionization computed from this dependence agrees well with the directly measured total cross section. The total cross section shows an order of magnitude of 10^{-19} cm^2 and increases slightly with collision energy. The differential cross section, independent of collision energy, possesses a maximum at a collision parameter of 3.5×10^{-10} cm. Results are compared with available models. (tr-auth)

26419 STUDIES OF ELECTRON-IMPACT EXCITATION, NEGATIVE-ION FORMATION, AND NEGATIVE-ION-MOLECULE REACTIONS IN BORON TRIFLUORIDE AND BORON TRICHLORIDE. Stockdale, J. A.; Nelson, D. R.; Davis, F. J.; Compton, R. N. (Oak Ridge National Lab., Tenn.). J. Chem. Phys.; 56: No. 7, 3336-41(1 Apr 1972).

Electron attachment processes in BF_3 and BCl_3 were studied with both electron swarm and electron beam techniques. Thermal electron attachment rates were determined by the drift–dwell–drift technique to be $< 5 \times 10^5$ s^{-1} · torr^{-1} for BF_3 and 9×10^7 s^{-1} · torr^{-1} for BCl_3. Beam studies showed that F^-, F_2^-, and BF_2^- were produced from BF_3 by electrons of energy near 11.5 eV, and Cl^- and Cl_2^- were produced in BCl_3 near 1 eV. The SF_6^- threshold electron-impact excitation spectrum of BF_3 exhibited no structure; however, a number of peaks were seen in BCl_3, the chief one being near 7.6 eV. A low-energy peak was observed in BCl_3 at ~2.5 eV. The thermal energy SF_6^{-*} ion was found to react readily with both BF_3 and BCl_3, yielding BF_4^- and BCl_3F^-, respectively. BF_4^- was also produced through the reaction $F_2^-/BF_3 + BF_3 \rightarrow BF_4^- + F$. Thermal-energy rate constants for these reactions determined by a pulsed source method were 1.8×10^{-9}, 1.6×10^{-10}, and 6.1×10^{-11} cm^3 molecules^{-1} · s^{-1} in the order above. (auth)

26420 DETERMINATION OF INTERMOLECULAR POTENTIALS BY THE INVERSION OF MOLECULAR-BEAM SCATTERING DATA. III. HIGH-RESOLUTION MEASUREMENTS AND POTENTIALS FOR K–Hg AND Cs–Hg. Buck, U.; Kick, M.; Pauly, H. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen, Ger.). J. Chem. Phys.; 56: No. 7, 3391-7(1 Apr 1972).

High-resolution differential scattering cross-section measurements for K–Hg and Cs–Hg were made using the method of crossed molecular beams. Up to 10 rainbow maxima for K–Hg and up to 14 rainbow maxima for Cs–Hg were resolved. The intermolecular potentials were obtained from these data by direct inversion, employing the procedure described in Papers I and II. The shape of the reduced potentials for all three of the alkali-metal–mercury systems determined up to now by use of this inversion procedure is the same, to within the experimental errors, but it deviates significantly from that of model potentials commonly used. (auth)

26421 ABSOLUTE TOTAL SCATTERING CROSS SECTION OF He–H_2 OVER THE RELATIVE VELOCITY RANGE OF 2000 TO 3000 m/sec. Grace, R. S.; Skofronick, J. G. (Florida State Univ., Tallahassee). J. Chem. Phys.; 56: No. 7, 3403-13(1 Apr 1972).

Absolute helium–hydrogen-molecule total cross sections for thermal-energy collisions were measured using molecular beams derived from nozzle sources and crossed at right angles. Both nozzles were adjustable in temperature over limited ranges to provide variation in the relative velocities. The absolute density of the target gas (H_2) was measured with a capacitance manometer. Over a relative velocity range of 2000 to 3000 m/s the cross sec-

tion, corrected for finite angular resolution, was found to be nearly constant in magnitude averaging 48 Å^2. A spherical potential that best fits the experimental data [Lennard-Jones (12, 6), ϵ = 0.7 meV, r_m = 3.57Å] was obtained for atom–molecule separations of 2.7 to 3.3 Å. The range was determined from the response of the cross section to piecewise variation of the theoretical potential. The results are consistent with previously reported theoretical and experimental works. (auth)

26422 EFFECTIVE LONG-RANGE POTENTIAL FOR SCATTERING OF ELECTRONS BY ATOMS AND MOLECULES. Huo, Winifred M. (Carnegie-Mellon Univ., Pittsburgh). J. Chem. Phys.; 56: No. 7, 3468-81(1 Apr 1972).

An effective potential $\tilde{V}_{f0}$ is defined such that the direct scattering amplitude is expressed by a Born-type integral. It is found that $\tilde{V}_{f0}$ consists of three types of potentials characterized by their q dependence, where q is the distance between the incident electron and the scattering center. The long-range potential, $\tilde{V}_{f0}^{LR}$, is important at large q. It is expressed as an inverse power series and expressions up to the q^{-6} term are obtained. The first non-Born term in $\tilde{V}_{f0}^{LR}$ is just the dipole polarization potential. The next term is proportional to q^{-5} and complex. The oscillatory potential, $\tilde{V}_{f0}^{OS}$, is also expressed as an inverse power series but multiplied by e^{iaq}. The leading term in $\tilde{V}_{f0}^{OS}$ is proportional to q^{-4}. Because of the presence of the oscillatory factor, $\tilde{V}_{f0}^{OS}$ will decrease faster than $\tilde{V}_{f0}^{LR}$ at large q. At small q, the short-range potential $\tilde{V}_{f0}^{SR}$ becomes important. It is characterized by an exponential dependence on q. The symmetry properties of $\tilde{V}_{f0}^{LR}$ and $\tilde{V}_{f0}^{OS}$ are studied and compared with the selection rules recently obtained by Lassettre. For elastic scattering, a semiempirical effective potential is introduced, which incorporates the leading terms in $\tilde{V}_{00}^{LR}$ and $\tilde{V}_{00}^{OS}$. It is found that some recent experimental results of Bromberg can be qualitatively accounted for by this potential. (auth)

26423 THEORY OF SEMICLASSICAL TRANSITION PROBABILITIES (S MATRIX) FOR INELASTIC AND REACTIVE COLLISIONS. UNIFORMIZATION WITH ELASTIC COLLISION TRAJECTORIES. Marcus, R. A. (Univ. of Illinois, Urbana). J. Chem. Phys.; 56: No. 7, 3548-50(1 Apr 1972).

A canonical transformation is described for uniformizing the coordinates used in Paper I of this series. For comparison with the results of Paper III, which based a uniformization on exact trajectories, the present article describes one based on elastic collision trajectories. The question of invariance of S-matrix elements with respect to semiclassical unitary transformations is also discussed. (auth)

26424 CLASSICAL TRAJECTORY STUDY OF ENERGY TRANSFER IN SOME ATOM–DIATOMIC MOLECULE SYSTEMS. Thompson, Donald L. (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys.; 56: No. 7, 3570-80(1 Apr 1972).

Atom–diatomic-molecule energy transfer was studied using classical trajectories. The main objective was to evaluate the effects of initial vibrational, rotational, and translational energy on energy transfer so that some understanding of the dynamical mechanism of energy transfer in these systems could be obtained. The four collision systems studied are H_2 + I, H_2 + Cl, HCl + H, and HCl + Cl. The initial states of these three-dimensional trajectories were chosen in accordance with quantum rules. The potential-energy surfaces employed in the calculation were of the semiempirical valence-bond formalism. The H-atom exchange reaction Cl′ + HCl′′ → HCl′ + Cl′′ was shown to be a contributor in the relaxation of vibrationally excited HCl molecules. (auth)

26425 NEAR-RESONANT ELECTRONIC ENERGY TRANSFER FROM ARGON TO HYDROGEN. Fink, Ewald H. (Univ., Bonn. Univ. of California, Berkeley); Wallach, Daniel; Moore, C. Bradley. J. Chem. Phys.; 56: No. 7, 3608-18(1 Apr 1972).

The argon sensitized fluorescence of molecular hydrogen has been observed. Relative cross sections were determined for transitions of the type $H_2(X\ ^1\Sigma_g^+, v = 0, J) + Ar^* \rightarrow H_2(B\ ^1\Sigma_u^+, v', J') + Ar + \Delta E$, where Ar* is either Ar $4s[1\frac{1}{2}]_{J=1^0}$ or Ar $4s'[\frac{1}{2}]_{J=1^0}$ and the hydrogen molecules, H_2, D_2, and HD are initially thermally distributed among J states at 300 ± 3°K. Calculations indicate that the largest cross sections, on the order of gas kinetic or larger, are due primarily to long-range dipole–dipole interactions. These cross sections are for transitions for which $|\Delta E| < 100\ cm^{-1}$ when $\Delta J \equiv J' - J = \pm 1$. The long-range dipolar calculations establish an absolute magnitude scale for the cross sections. A curve-crossing mechanism is possible for negative ΔE and provides a plausible explanation for the remaining levels excited. Generally, only one vibrational level of the hydrogen molecule is excited by each argon state. This contrasts sharply with many previous sensitized excitation experiments in which most of the energetically accessible energy levels are excited. (auth)

26426 MEASUREMENT OF ELECTRON-IMPACT EXCITATION FUNCTIONS FOR SINGLET AND TRIPLET LEVELS IN HELIUM. Showalter, John Gordan. Washington, D. C.; American Univ. (1971). 137p. University Microfilms Order No. 72-9172.

Thesis.

Excitation functions and pressure dependences of the apparent cross sections for the 4^1S, 5^1S, 3^1P, 4^1P, 5^1P, 3^1D, 4^1D, 5^1D, 4^3S, 5^3S, 3^3P, 3^3D, and 4^3D levels are obtained at selected energies between 40 and 800 eV. The excitation functions of the n^3S levels are found to be monotonically decreasing with energy at a slope of −3.0 ± 0.2. The n^3D and to a lesser extent the 3^3P excitation functions are composed of two energy dependences, a slow one attributed to mixed F-level cascade and an initially dominant fast component due to exchange excitation. The fast component falls as $E^{-3.5\pm.02}$ and $E^{-3.7\pm0.5}$ for the 3^3P and n^3D levels, respectively. The n^1P apparent cross sections are found to scale as 1/E lnE above 150 eV. The n^1D apparent cross sections scale as 1/E above 100 eV but the n^1S do not quite scale as 1/E at 500 eV and probably do not become "Born-like" until much higher energies are reached. (Diss. Abstr. Int., B)

26427 ELECTRON IMPACT CROSS SECTIONS AND RATES FOR EXCITATION AND IONIZATION OF HYDROGEN AND HYDROGENIC IONS. Golden, Lawrence Bennett. University Park, Pa.; Pennsylvania State Univ. (1971). 129p. University Microfilms Order No. 72-9468.

Thesis.

Two simple, general representations for the excitation and ionization cross sections in hydrogen were obtained, which give agreement with all the well-established data to within ~25%. Transition rates corresponding to these cross sections were obtained. For excitation they exceed those of most previous proposals, especially for transitions other than the n → n + 1 transitions. For ionization, the representations approximately bracket the experimental results and appear to represent the present uncertainty of the cross sections. For hydrogenic ions, a simple, general representation for the excitation and ionization cross sections was obtained. Since there was not sufficient well-established data available for the hydrogenic ion case, Coulomb–Born calculations were carried out for the n = 1 → n′ = 3 and n = 2 → n′ = 3 transitions. These calculations along with previous calculations and experimental results for the ionization cross sections from the ground level provide sufficient data to obtain an accurate representation of these cross sections. Transition rates were obtained corresponding to these cross sections. Semi-empirical cross sections and rates were also obtained for transitions between the sublevels, nl, for n ≤ 3 in hydrogen and hydrogenic ions. A prescription for the rates for transitions from these sublevels to higher levels and the continuum was also given. In addition, an accurate approximate method of including collisional excitation rates for transitions from a given level to highly excited levels with the rate for ionization from the same level is described. This method can only be applied when the upper level is in LTE with the free electrons. (Diss. Abstr. Int., B)

26428 DIFFERENTIAL SCATTERING OF H^+ AND He^+ FROM THE RARE GASES. Carlston, Carl Ernest. Charlottesville, Va.; Univ. of Virginia (1971). 68p. University Microfilms Order No. 72-7281.

Thesis.

Absolute differential ion and charge-transfer scattering cross sections are measured for the collisions of H^+ and He^+ with He, Ne, Ar, and Kr in the energy range 500 to 5000 eV. Ions scattered elastically and ions scattered inelastically as a result of excitation of the target atom are measured together and are referred to as the ion scattering cross section. Ions that become neutralized in the collisions (i.e., charge-transferred) are measured separately as absolute scattered neutral flux. The measurements are used to determine the nature and range of applicability of interatomic potentials that may describe the nuclear trajectories in the collisions investigated. (Diss. Abstr. Int., B)

26429 ELECTRON-IMPACT IONIZATION OF SINGLY AND DOUBLY CHARGED IONS. Mathur, K. C.; Tripathi, A. N.; Joshi, S. K. (Univ. of Roorkee, India). J. Mass Spectrom. Ion Phys.; 4: No. 6, 483-8(Sep 1970).

The electron-impact ionization cross sections of singly and doubly charged ions, Ar^+, Kr^+, Xe^+, Ba^+, Sr^+, Sn^+, Ag^+, Hg^+, Cd^+, Zn^+, Ar^{++}, Kr^{++}, Xe^{++}, and Hg^{++}, were calculated for incident electron energies up to 1000 eV using the method of Thomas and Garcia. The results of the calculation are compared with available experimental data. (auth)

26430 EXACT SERIES SOLUTION OF CLASSICAL DEFLECTION ANGLE FOR REPULSIVE INVERSE POWER POTENTIAL.

Gislason, E. A. (Univ. of Illinois, Chicago). J. Chem. Phys.; 56: No. 6, 2493-7(15 Mar 1972).

An exact series solution of the classical deflection angle is developed for the potential $V = C/r^3 (C > 0)$. The series converges at all impact parameters. In addition, upper and lower bounds for θ are constructed from the series as an aid to numerical computation. Finally, the classical differential cross section is evaluated from the deflection angle. (auth)

26431 EFFECTS OF AN ATTRACTIVE WELL POTENTIAL ON THE ATOM-DIATOMIC-MOLECULE COLLINEAR COLLISION. Secrest, Don; Eastes, Walter (Univ. of Illinois, Urbana). J. Chem. Phys.; 56: No. 6, 2502-7(15 Mar 1972).

The effect on the vibrational transition probability of an attractive well in the interaction potential for the collinear collision of an atom with a diatomic oscillator is investigated. Two forms of the potential are considered. For a square barrier potential, a square well introduces sharp resonances in the transition probability. It is shown that the position of these resonances may be predicted by a simple formula. For a "soft" Morse interaction potential no resonances are observed. It is shown in this case that the transition probability is determined more by the slope of the potential at the classical turning point than by the presence or absence of an attractive well. (auth)

26432 THEORY OF INELASTIC COLLISIONS: UNIFORM ASYMPTOTIC (WKB) SOLUTIONS AND SEMICLASSICAL SCATTERING MATRIX ELEMENTS FOR MULTICHANNEL PROBLEMS. Eu, Byung Chan (McGill Univ., Montreal). J. Chem. Phys.; 56: No. 6, 2507-16(15 Mar 1972).

The method developed for the semiclassical solutions of two-channel problems is generalized for a semi-classical solution of multichannel problems. The semiclassical scattering matrix elements are constructed from the solution; they are given in terms of well-defined quadratures involving the Airy functions. The results obtained are valid without curve crossings and do not require the usual assumption of a sufficiently wide separation of the turning points and crossing points. It is shown that an approximate solution of an N-channel problem can be constructed from the solutions of local two-channel problems, if the curves cross pairwise in sequence. (auth)

26433 DECONVOLUTION OF MOLECULAR-BEAM INELASTIC SCATTERING DATA. Gillen, Keith T.; Mahan, Bruce H. (Univ. of California, Berkeley). J. Chem. Phys.; 56: No. 6, 2517-24(15 Mar 1972).

Two deconvolution techniques and their application to large-angle scattering of molecular beams are considered. The first method, an iterative unfolding (IU) technique due to Ioup and Thomas, is shown to contain an error; this error is corrected, but still further limitations are shown to exist. The second deconvolution method, which involves a folding together of apparatus and assumed scattering functions, is used to analyze some data previously analyzed by the IU method. The new results in every case show that average (vibrational) inelasticities were overestimated both by analysis of the scattering results without deconvolution and by application of the IU method. The reason for the original overestimate is quite general and is easily understood. A simple classical theory agrees reasonably well with the new energy transfer values over a wide range of collision energy. (auth)

26434 FORMATION OF HS^- AND DS^- BY DISSOCIATIVE ATTACHMENT IN H_2S, HDS, AND D_2S. Fiquet-Fayard, F.; Ziesel, J. P.; Azria, R.; Tronc, M.; Chiari, J. (CNRS, Orsay, France). J. Chem. Phys.; 56: No. 6, 2540-8(15 Mar 1972).

The formation of HS^- by dissociative attachment was studied in a total ionization chamber, with a RPD electron gun. The onset of the ionization efficiency curve (1.45 ± 0.1 eV) is equal to the minimum energy necessary for the formation of HS^- (1.55 ± 0.03 eV). Nevertheless the curve does not exhibit the usual shape characteristic of a vertical onset process. The cross section at the maximum is $\sigma(HS^-/H_2S) = 1.7 \times 10^{-18}$ cm^2. The isotope effects were measured separately in a mass spectrometer, and it was found that the cross section in D_2S is much smaller: $\sigma(HS^-/H_2S)/\sigma(DS^-/D_2S) = 25 \pm 3$. An attempt was made to reproduce the experimental results by a semiempirical calculation, using the expression of O'Malley for the cross section and parameterizing the final-state potential curve of the negative ion. It is shown that the experimental results are consistent with the assumption of a very shallow bound potential in the Franck–Condon region. Quantitative calculations are impossible because the formula of O'Malley is incorrect for that sort of potential curve. (auth)

26435 PARTIAL CHARGE-TRANSFER REACTIONS AT THERMAL ENERGIES. Spears, K. G.; Fehsenfeld, G. C.; McFarland, M.; Ferguson, E. E. (NOAA Environmental Research Labs., Boulder, Colo.). J. Chem. Phys.; 56: No. 6, 2562-6(15 Mar 1972).

Thermal-energy reaction rate constants are reported for the partial charge-transfer reactions $Ca^{2+} + NO \rightarrow Ca^+ + NO^+$ and $Mg^{2+} + X \rightarrow Mg^+ + X^+$ with X as Xe, NO, O_2, N_2O, CO_2, CO, SO_2, NH_3, and NO_2. The rate constants for single-electron transfer of polyatomic neutrals are often three orders of magnitude larger than the rate of electron transfer from Xe. Within a curve-crossing model the molecular data yield approximate efficiencies of electron transfer from 2.5 to 14.4 Å. The difficulties of using a curve-crossing model for polyatomic molecules and a simple Landau–Zener calculation at thermal energies are briefly discussed. (auth)

26436 COMPUTATIONAL APPROACH TO THE CONSTRUCTION OF THE OPTICAL POTENTIAL. Wolken, George Jr. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen, Ger.). J. Chem. Phys.; 56: No. 6, 2591-6(15 Mar 1972).

Atom–diatomic-molecule scattering is considered in the close-coupling approximation. It is shown how a local optical-potential matrix can be constructed such that scattering from this optical potential reproduces exactly a specified submatrix of a given multichannel (and arbitrarily accurate) transition matrix (T). However, these two requirements on the optical potential (that it be local and reproduce a given submatrix of T) do not define it uniquely. For the special case of open channels a T (R) is defined such that $T(\infty) = T$. Requiring the optical potential to be local and reproduce a specified submatrix of T (R) at every R does lead to a unique (and quite simple) result capable of trivial generalization to closed as well as open channels. $H + H_2$ rotationally inelastic scattering, neglecting exchange, is considered as an example. (auth)

26437 MEASUREMENT OF LOW-ENERGY SCATTERING CROSS SECTIONS FOR THE He–N_2 SYSTEM. Collins, Frank G.; Hurlbut, Franklin C. (Univ. of California, Berkeley). J. Chem. Phys.; 56: No. 6, 2609-16(15 Mar 1972).

Total elastic-scattering cross sections for the He–N_2 system were measured for relative velocities from 1.68×10^4 to 1×10^5 cm/s utilizing the crossed-beam technique. An orbiting resonance below the j = 0 to 2 transition was observed. Two collimated, aerodynamically intensified molecular beams intersecting at 10° were used. Each beam had a speed distribution comparable to that obtained from mechanical velocity selectors. The scattering center density was determined from a calibration of the detector utilizing a thermal beam source, carefully considering the geometry of the system. Attenuation of the scattering signal due to the background gas was determined without recourse to pressure-gauge readings. One beam was modulated and integrating techniques were used to recover the signal. The time-of-flight technique was used to determine the initial conditions in each beam. The measurements were compared with quantum mechanical calculations performed at the University of Bonn using a Lennard-Jones (12,6) potential. Generally, the measurements were larger than these calculations, but one resonance was partially resolved. (auth)

26438 COLLISION INTEGRALS FOR ISOTOPIC HYDROGEN MOLECULES. Brown, Nancy Jeanne; Munn, Robert J. (Univ. of Maryland, College Park). J. Chem. Phys.; 56: No. 6, 2761-5 (15 Mar 1972).

Elastic collisions involving o-H_2 + p-H_2 and p-H_2 + HD were studied. The molecules interacted with a Lennard-Jones type potential modified to include angular terms. A set of cross sections, $Q^{(l)}$, and collision integrals, $\Omega^{(l,s)}(T)$, were obtained for each system. Collision integrals and thermal diffusion factors were calculated for p-H_2 + HD both with and without the angle-dependent terms in the potential. The cross sections showed a small degree of sensitivity to the angular terms in the potential and to differences in the reduced mass of the systems. The collision integrals were quite insensitive to the angle-dependent terms of the potential. The calculated thermal diffusion factor for each H_2 + HD case differed from the experimental value by approximately a factor of 2. (auth)

26439 ELECTRON-IMPACT EXCITATION OF NITRIC OXIDE. Stone, E. J.; Zipf, E. C. (Univ. of Pittsburgh). J. Chem. Phys.; 56: No. 6, 2870-4(15 Mar 1972).

The absolute cross sections for the excitation of the NO^+ Baer–Miescher bands ($A\,^1\Pi_u \rightarrow X\,^1\Sigma_g^+$), two nitric oxide β' bands ($B'\,^2\Delta_i \rightarrow X\,^2\Pi_r$), and several atomic nitrogen multiplets in the vacuum ultraviolet by electron impact on NO were measured over an energy range extending from threshold to 300 eV. The variation of the dipole transition moment for the NO^+ ($A\,^1\Pi_u \rightarrow X\,^1\Sigma_g^+$) band system was also determined. (auth)

26440 ABSORBING-SPHERE MODEL FOR CALCULATING ION–ION RECOMBINATION TOTAL CROSS SECTIONS. Olson, Ronald E. (Stanford Research Inst., Menlo Park, Calif.). J. Chem. Phys.; 56: No. 6, 2979-84(15 Mar 1972).

An absorbing-sphere model based on the Landau–Zener method is set up for calculating the upper-limit thermal-energy (300°K) reaction rate and the energy dependence of the total cross sections for the ion–ion recombination reaction, $A^+ + B^- \rightarrow A^* + B + \Delta E$, in which A or B may be atomic or molecular species. The crucial parameter needed for the calculation is the electron detachment energy for the outer electron on B^-. For a given system and energy, it is found that, as the electron detachment energy is decreased because of the existence of metastable electronic states or excited vibrational states, the cross sections increase. The calculated cross sections and rates are compared with afterglow results and with those obtained from merged-beam experimental data. Good agreement is found with the existing results for atomic negative ions. There are differences for molecular negative ions, and the possible cause of these differences is discussed. (auth)

26441 TRANSMISSION PROPERTIES OF A $LiF-O_2$ FILTER FOR RADIATION RESULTING FROM ELECTRON IMPACT ON H_2: CROSS SECTION FOR LYMAN-α RADIATION. Carriere, J. D.; De Heer, F. J. (FOM-Instituut voor Atoom-en Molecuulfysica, Amsterdam). J. Chem. Phys.; 56: No. 6, 2993-6(15 Mar 1972).

In many experiments Lyman-α radiation has been detected by means of the iodine-vapor-filled ultraviolet photon counter of Brackmann, Fite, and Hagen in combination with a $LiF-O_2$ filter. In the case of electrons incident on molecular hydrogen, Fite and Brackmann have used the detector for determination of the cross section for "countable ultraviolet radiation" (cuv) being chiefly composed of Lyman-α radiation and an unknown fraction of molecular radiation. In the present investigation the transmission properties of the $LiF-O_2$ filter are investigated. At 100 eV impact energy it is found that 26% of the transmitted radiation is molecular radiation. Considering this fraction, it is possible to evaluate the cross sections for Lyman-α radiation from Fite and Brackmann's cuv cross sections. These cross sections agree very well (within about 6%) with those of de Heer and Carrière, obtained by a different procedure. (auth)

26442 THERMAL-ENERGY REACTION RATE CONSTANTS FOR H^+ AND CO^+ WITH O AND NO. Fehsenfeld, F. C.; Ferguson, E. E. (NOAA Environmental Research Labs., Boulder, Colo.). J. Chem. Phys.; 56: No. 6, 3066-70(15 Mar 1972).

Thermal-energy rate constants for the charge transfer of CO^+ with O and NO were measured to be 1.4 and 3.3×10^{-10} cm^3/s at 300°K. The rate constants for H^+ with O and NO are 3.8 and 19×10^{-10} cm^3/s. The $H^+ + O$ charge-transfer data agree remarkably well with the value extrapolated from crossed-beam studies at much higher energies. (auth)

26443 MOLECULAR-BEAM DETERMINATION OF MERCURY–RARE-GAS INTERMOLECULAR POTENTIALS. Powers, T. R.; Cross, R. J. Jr. (Yale Univ., New Haven). J. Chem. Phys.; 56: No. 6, 3181-2(15 Mar 1972).

Measurements of total cross sections for beams of ground-state Hg atoms and the rare gases from 200 to 1000 eV are described briefly. The measured cross sections are shown graphically and the corresponding intermolecular potentials are listed. (A.G.W.)

26444 DISSOCIATIVE EXCITATION OF H_2. Czarnik, John Wolfgang. Corvallis, Oreg.; Oregon State Univ. (1972). 78p. University Microfilms Order No. 72-5089.

Thesis.

The observation of structure in the time-of-flight (TOF) distribution of metastable H (2S) atoms produced with kinetic energies less than one electron volt by dissociative excitation is the primary result of the work presented. The principal difference between the present experimental procedure and previous work is the use of effective cooling of the target molecules through the use of nozzle flow of the H_2 molecules. This effective temperature reduction allows recognition of structure that was not evident in earlier investigations. The excitation and detection techniques employed are similar to those used previously. Excitation is achieved by a pulsed electron source. Metastable H (2S) atoms produced by dissociative excitation of H_2 are detected at a distance L from the excitation region by quenching the metastable level and subsequent detection of the Lyman-α (1216 A) de-excitation radiation by a Bendix Model 450 channel electron multiplier. The structure observed in the TOF spectrum of metastable H (2S) atoms is interpreted as evidence of a large extent of predissociation in the dissociative excitation of H_2. Several of the peaks in the TOF distribution are consistently interpretable as due to predissociation of the $D^1\pi u$ (v = 3, 4, 5, 6) excited states of H_2. It is indicated that exceptional broadening of peaks observed in independent spectral studies is caused by predissociation of the $8p\sigma$ (v = 4, 5) or $9p\sigma$ (v = 5) Rydberg states of H_2. All of the results regarding resolution limit and dependence on the temperature of the target molecules are demonstrated to be consistent with the theory of Stanton and Monahan. (TSS) (Diss. Abstr. Int., B)

Atomic Theory

Refer also to abstracts 26733 and 27357.

26445 (UCRL-Trans-10587) IONIZATION OF HYDROGENOID ATOMS BY A MULTIPHOTONIC ABSORPTION PROCESS. Gontier, Yves; Trahin, Michel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Translated for Univ. of California, Lawrence Livermore Lab., Livermore, from report CEA-R-3192. 27p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 37092.

26446 SECOND-ORDER PERTURBATION TERM IN IONIZATION POTENTIALS OF THREE- TO TEN-ELECTRON SYSTEMS. Edlen, B. (Univ. of Lund, Sweden). Phys. Rev. Lett.; 28: No. 15, 943-4(10 Apr 1972).

The constant term in semi-empirical expressions for the Z dependence of observed ionization potentials of three- to ten-electron systems is compared with results of theoretical calculations of the second-order perturbation energy. (auth)

26447 CALCULATION OF ATOMIC ENERGY LEVEL VALUES. Radziemski, Leon J. Jr. (Los Alamos Scientific Lab., N. Mex.); Fisher, Kay J.; Steinhaus, David W.; Goldman, Aaron S. Comput. Phys. Commun.; 3: No. 1, 9-18(Jan-Feb 1972).

Program LEVEL calculates the best values for the energy levels of an atomic system and their uncertainties. The normal equations obtained from the least-squares formulation are partitioned to reduce the size of the matrix to be inverted to the magnitude of the smaller set of energy levels. The variance–covariance matrix is used to compute corrections to the values of the energy levels and to compute variances on the levels and on the computed wave numbers. Calculation of level isotope shifts can also be made. The program is written in FORTRAN IV for the CDC 6600. (A.G.W.)

26448 WAVE NUMBER CALCULATION FROM LEAST-SQUARES LEVEL VALUES. Radziemski, Leon J. Jr. (Los Alamos Scientific Lab., N. Mex.); Fisher, Kay J.; Steinhaus, David W.; Goldman, Aaron S. Comput. Phys. Commun.; 3: No. 1, 19-21(Jan-Feb 1972).

Program CALOR calculates wave numbers from least-squares energy-level values calculated by program LEVEL (Comput. Phys. Commun., 3: 9-18(1972)). Only allowed transitions ($\Delta J = 0, \pm 1$) can be calculated. (A.G.W.)

26449 CALCULATION OF COEFFICIENTS IN POWER SERIES EXPANSION OF LONG-RANGE DISPERSION FORCE BETWEEN ATOMS. Starkschall, George; Gordon, Roy G. (Harvard Univ., Cambridge, Mass.). J. Chem. Phys.; 56: No. 6, 2801-6(15 Mar 1972).

By applying an Unsöld approximation to the expression for the second-order perturbation energy between two atoms and assuming no overlap of charge distributions, an expression was derived for C_{2n}, the coefficient of the R^{-2n} term in the attractive potential, in terms of C_6 and ground-state averages of even powers of the electron–nucleus distance in the isolated atom. Values of C_8 and C_{10} are calculated for H, He, Ne, Ar, and Kr, and estimates are made as to the accuracy of the calculations. Several comments are made on the convergence of the power series expression for the second-order energy. (auth)

26450 THEORY FOR THE FORCES BETWEEN CLOSED-SHELL ATOMS AND MOLECULES. Gordon, Roy G.; Kim, Yung Sik (Harvard Univ., Cambridge, Mass.). J. Chem. Phys.; 56: No. 6, 3122-33(15 Mar 1972).

A simple model is presented for calculating the forces between closed-shell atoms and molecules in the regions both of the attractive well and of the repulsive wall at shorter distances. Account is taken of both the overlap of the separate atomic densities and of electron correlation. Applications to pairs of rare gas atoms and to alkali halide molecules demonstrate quantitative agreement with empirically determined intermolecular potentials for these systems over the whole range of separations inside and including the potential minimum. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

26451 STABILITY OF ELECTROSTATIC ION WAVES IN ELECTROGASDYNAMIC CHANNEL FLOWS. Brunne, M. (Inst. of Fluid-Flow Machines, Danzig). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 19: No. 11-12, 871-83(1971).

The propagation of small perturbations in electrogasdynamic flows in channels is considered. The dispersion equations are given for electrostatic ion waves generated in flows. Approximate solutions of the equations are discussed, and examples of exact numerical solutions are given. In the dispersion equation, the part describing the waves of frequencies dependent solely on the flow geometry is separated. The stability of these waves is analyzed. Within the frames of the considered diffusional approximation, there is a critical wavelength depending on the Debye radius and flow geometry and on the determination of the stability limit for the perturbations propagating in ionic gas. (auth)

26452 TRANSPORT PHENOMENA (HEAT, MASS, AND ELECTRICAL CHARGE) WITH CHEMICAL REACTION NEAR A WALL IN A PLASMA JET. Rowe, Bertrand; Lassau, Gerard (CNRS, Meudon, France). pp FC9.7.1-10 of Heat Transfer 1970. Vol. III. /Grigull, Ulrich (ed.). Amsterdam; Elsevier Publishing Co. (1970). (In French).

From fourth international heat transfer conference; Paris-Versailles, France (31 Aug 1970).

The experimental study of a laminar boundary layer on a flat plate with perpendicular wall injection of different gases is described. The external flow is a nitrogen or an argon plasma. The measured profiles show that transport phenomena depend heavily upon the dissociation features of the injected gases. It appears that, for some gases, a very small injection rate provides effective electrical and thermal wall insulation from the plasma jet. (auth) (France)

26453 THREE-DIMENSIONAL MAGNETOHYDRODYNAMIC FLOW BETWEEN TWO POROUS DISKS. Chandrasekhara, B. C.; Rudraiah, N. (Bangalore Univ., India). Appl. Sci. Res. (The Hague); 25: No. 3-4, 179-92(Dec 1971).

Conducting flow in the gap between two parallel coaxial nonconducting disks, one of which is rotating and the other stationary, in the presence of a uniform axial magnetic field is studied. The effect of uniform suction or injection on the velocity distribution is investigated, and asymptotic solutions are obtained for $R \ll M^2$. Expressions for the average normal force and the torque on the disks are obtained. It is found that all components of velocity are affected by uniform suction or injection and, in particular, it is noted that the effect of suction or injection on the radial component of velocity predominates over the effect of rotation for a given Hartmann number. (auth)

26454 OVERLOOKED PERTURBATIONS. Callebaut, D. K. (Rijksuniversiteit, Ghent). Phys. Lett.; 39A: No. 1, 73-4 (10 Apr 1972).

An important class of overlooked MHD perturbations is reported. For incompressible fluids, the class consists of perturbations that cannot be written as gradients. (auth)

26455 VISCOUS AND ELECTRICALLY CONDUCTING FLUID FLOW AROUND A MAGNETIZED SPHERE. Fleury, Francoise (Univ., Paris). Compt. Rend., Ser. A; 274: No. 3, 271-4(17 Jan 1972). (In French).

The stationary flow with revolution symmetry of a viscous, incompressible, and electrically conducting fluid around a solid sphere, at the center of which is placed a magnetic dipole whose axis is parallel to the flow direction, is studied. (France)

26456 EXPERIMENTAL STUDY OF THE PERMANENT ELECTROMAGNETIC COUPLING OF TWO ONE-DIMENSIONAL STEADY LAMINAR FLOWS OF VISCOUS ELECTRICALLY CONDUCTING LIQUID IN THE PRESENCE OF A UNIFORM TRANSVERSE MAGNETIC FIELD. Dorlhac, Francois; Bas, Jacques (College Scientifique Univ., Avignon, France). Compt. Rend., Ser. A; 274: No. 3, 275-7(17 Jan 1972). (In French).

An attempt was made to experimentally verify the theory of electromagnetic coupling of two one-dimensional flows of viscous electrically conducting liquid, in the presence of a transverse magnetic field, for different values of the ratio of their characteristic dimensions and Hartmann numbers. Steady conditions, either static or dynamic, were envisaged for the induced flow. (France)

PHYSICS (HIGH-ENERGY)

Refer also to abstract 26250.

Particle Interactions and Properties (Experimental)

Electromagnetic

Refer also to abstracts 26413, 26416, 26554, 26600, and 26794.

26457 (KFKI-71-83) MOMENTUM ESTIMATION OF ELECTRONS TRAVERSING HEAVY MEDIA IN HOMOGENEOUS MAGNETIC FIELD. II. Nagy, E. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). [ndl. 17p. Dep. NTIS (U. S. Sales Only).

The method proposed in E. Nagy, KFKI 70-10 HEP was tested experimentally both on a monochromatic positron beam traversing a heavy liquid bubble chamber and on γ rays produced in high energy interaction of K^+ mesons with the nuclei of a heavy liquid bubble chamber. (auth)

26458 (N-72-13631) MEASUREMENT OF THE NUCLEAR ELECTROMAGNETIC CASCADE DEVELOPMENT IN GLASS AT ENERGIES ABOVE 200 GeV. Gillespie, C. R.; Huggett, R. W.; Humphreys, D. R.; Jones, W. V.; Levit, L. B. (Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy). [1971]. 5p. (NASA-CR-124697; HE-58). NTIS.

The longitudinal development of nuclear-electromagnetic cascades with energies greater than 200 GeV was measured in a low-Z (glass) absorber. This was done in the course of operating an ionization spectrometer at mountain altitude in an experiment to study the properties of gamma rays emitted from individual interactions at energies around 10,000 GeV. The ionization produced by a cascade is sampled by 20 sheets of plastic scintillator spaced uniformly in depth every 2.2 radiation lengths. Adjacent pairs of scintillators are viewed by photomultipliers which measure the mean ionization produced by an individual cascade in 10 layers each 1.1 interaction length (4.4 radiation lengths) thick. The longitudinal development of the cascades was measured for about 250 cascades having energies ranging from 200 to 2500 GeV. The observations are compared with the predictions of calculations made for this specific spectrometer using a three-dimensional Monte Carlo model of the nuclear-electromagnetic cascade. (auth) (STAR)

26459 (NP-19236) EXPERIMENTS ON ELECTRON-POSITRON COLLIDING BEAMS. Note No. 343. Conversi, M. (Rome Univ. (Italy). Istituto di Fisica). 18 Nov 1971. 43p. Dep. NTIS (U. S. Sales Only).

A review is given of recent results on the electron-positron storage rings at Orsay and Frascati. These results cover quantum electrodynamics, vector mesons, and multi-body hadronic events at high energies, and the baryon structure in the time-like region. Prospects for future work at Orsay and Frascati are also included. (J.F.P.)

26460 POSITRON-ELECTRON ANNIHILATION AT 1.0 GeV. Tso, Thomas Tung-wen. Ithaca, N. Y.; Cornell Univ. (1971). 110p. University Microfilms Order No. 72-8991.

Thesis.

The differential cross section for positron-electron annihilation was measured from 40° to 90° in the center of mass system. It tested the validity of quantum electrodynamics at a maximum momentum transfer of about 32 MeV/c. The measurement was compared to the theoretical calculation to order α^3 including the virtual photon correction, the soft photon correction and the three photon annihilation correction. The incident positron beam was monitored by a set of thin counters. The annihilation photons were detected by two symmetrical shower detectors consisting of copper converters and wire spark chambers. The shower detectors measured the centers of the photon initiated showers and the information was interfaced to a computer for on-line calculations and also recorded on magnetic tapes for off-line analysis. The absolute cross sections were measured to an accuracy of 1.5% (about 1% statistical error) and no discrepancy between the theory and the experimental results was observed. The measurement confirmed quantum electrodynamics to the limit of 510 MeV or to a distance of 0.39 fermi (one standard deviation). (Diss. Abstr. Int., B)

26461 SOME IMPRESSIONS OF EXPERIMENTAL PROGRESS IN WEAK INTERACTIONS. Cronin, J. W. (Princeton Univ., N. J.). J. Phys. (Paris), Colloq.; No. 3, 13-16(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

A review of some of the significant progress made in the understanding of weak interactions during the past seven years, is presented. Attention is drawn to some of the more outstanding problems and the prospects for new areas of research. (France)

26462 MUD EXPERIMENT. Gaillard, J. M. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 3, 123-4(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

An experiment is under way at the Stanford Linear Accelerator Laboratory to find out whether some unknown particle is making its way through a very thick shielding when exposed to an intense high-energy electron beam (between 13 and 19.5 GeV). Preliminary results are interesting enough to warrant a more extensive search. (France)

26463 SUMMARY TALK. Callan, C. G. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 3, 125-7(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

All the discussions concerning weak interaction problems held during the VIth meeting at Moriond, are reviewed. (France)

26464 PHOTOPRODUCTION OF LOW-MASS MUON PAIRS IN THE INELASTIC REGION. Hayes, Stanley Pearse. Ithaca, N. Y.; Cornell Univ. (1971). 106p. University Microfilms Order No. 72-8860.

Thesis.

An experiment was performed to measure the yield of muon pairs photoproduced from a carbon target. The muon pairs are produced at large angle (approximately $12\frac{1}{2}$ degrees) to the incident photon and have an invariant pair mass of less than 500 MeV. The kinematical region covered by the experiment requires that the momentum and energy transferred to the target be large. The experimental yield was compared to the yields expected from Bethe-Heitler pair production processes and from Compton pair production based on a parton model for the nucleons. The results indicate that the theoretical yields are too small. The ratio of the experimental yield to the total theoretical yield is 5.4 ± 1.4. (Diss. Abstr. Int., B)

26465 PHOTOPRODUCTION OF PI PLUS MESONS AT ONE HUNDRED EIGHTY DEGREES. Ekstrand, Kenneth Eric. Ithaca, N . Y.; Cornell Univ. (1971). 103p. University Microfilms Order No. 72-8844.

Thesis.

The photoproduction of positive π mesons was studied in the photon energy range from 0.66 to 7.4 GeV. Pions produced from hydrogen by a bremsstrahlung beam from the Cornell 10-GeV synchrotron were detected with a wide-gap spectrometer magnet and a system of scintillation counters and magnetostrictive wire spark chambers. The cross section averaged over the region from 170 to 180 degrees, the angular distribution, and the 180 degree cross section were determined from pion momentum spectra in the kinematic region in which only single pion production was possible. The cross section showed a rapid decrease with energy along with a series of dips and bumps at energies corresponding to the production of pion nucleon resonances. The data in the lower energy region were largely in agreement with that of previous measurements. In the higher energy region the data were compared with various Regge models. The agreement was best with models employing only simple Regge poles. (Diss. Abstr. Int., B)

26466 HIGH ENERGY PHYSICS WITH THE ORSAY STORAGE RING ACO. Buon, J. (Laboratoire de l'Acee'lerateur Lineaire Orsay, France). Particles Nucl.; 1: No. 2, 141-52(Nov 1970).

Experiments with the e^+e^- colliding beams of Orsay (ACO) are reported. Limits on the validity of quantum electrodynamics are obtained from the study of the pure electromagnetic e^+e^- interactions. The vector-meson ρ^0, ω, ϕ production in e^+e^- annihilations was extensively studied. Some parameters of these vector-mesons, especially their leptonic decay widths, are derived from the results. They are compared to theoretical predictions. (auth)

26467 PRECISION MEASUREMENT OF THE MAGNETIC MOMENT OF THE POSITIVE MUON. Williams, David Lamar. Seattle; Univ. of Washington (1971). 188p. University Microfilms Order No. 72-7431.

Thesis.

The magnetic moment of the positive muon was measured in this experiment using purely digital techniques. Positive muons whose momenta fell within a small momentum band at the upper end of the pion decay spectrum were focused and brought to rest in a liquid target situated in a stable and uniform magnetic field. Positrons from muon decay were detected after the muon spin had precessed for a time in the magnetic field. The resulting decay distribution was analyzed to obtain the muon precession frequency ω_μ/ω_p which was corrected for errors and systematic effects to yield the muon magnetic moment ratio $\mu_\mu/\mu_p = 3.1833466 \pm 0.0000075$ (2.4 ppM). The experimental data were later reanalyzed to obtain a precision value for the positive muon's lifetime $\tau_\mu = (2.20026 \pm 0.00074)$ μsec. (Diss. Abstr. Int., B)

26468 SINGLE π^0 PHOTOPRODUCTION FROM COMPLEX NUCLEI AT 2 AND 3 GeV. Abrahamyan, L. O.; Aganyants, A. O.; Adamyan, F. V.; (and others) (Erevan Physical Inst.). Phys. Lett. 38; B: No. 7, 544-8(3 Apr 1972).

The reaction $\gamma A \rightarrow A^* \pi^0$ was studied for Be, C, Al, Cu, Ag, Pb and CH_2 targets at photon energies $E_{\gamma max} = 2.05$ and 2.95 GeV and four momentum transfers $|t|$ respectively 0.3 and 0.58 $(GeV/c)^2$. The values obtained for Z_{eff} are shown to be independent, within the errors, of photon energies from 2 to 16 GeV (SLAC). A comparison was made with a theoretical calculation. The A-dependence of the ratio of π^-/π^+ production for these nuclei and the difference between the radius of proton-neutron distribution in Ag and Pb are given as well. (auth)

26469 PARTIAL CROSS SECTIONS FOR MULTIPION PHOTOPRODUCTION OFF DEUTERONS AT ENERGIES UP TO 5 GeV. Schiffer, R. (Technische Hochschule, Aachen); Schnackers, H. H. J.; Valdmanis, V.; (and others). Nucl. Phys.; B38: No. 2, 628-38(1972).

The 85 cm deuterium bubble chamber at DESY was exposed to a tagged bremsstrahlung beam with maximum energy of 5.5 GeV. Reactions with one neutral particle in the final state could be separated from those with more than one neutral particle. Cross sections for several multipion photoproduction channels off deuterons are presented. (auth)

26470 PRECISION MEASUREMENT AND FUNDAMENTAL CONSTANTS. Proceedings of the International Conference Held at Gaithersburg, Maryland, August 3-7, 1970. Langenberg, D. N.; Taylor, B. N. (eds.). Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 1-531(Aug 1971). (NBS-SPEC. PUBL.-343; CONF-700822).

The conference included 83 papers. Separate abstracts were prepared for 49 papers. Other papers were outside the scope of NSA. (J.F.P.)

For abstracts of individual papers see: 26395-26410, 26413-26416, 26471-26486, 26494, 26584, 26585, 26745-26749, 26793, 26794, 26835, 27128, and 27369.

26471 APPLICATION OF NUCLEAR RESONANCE TO THE MONITORING OF ELECTRICAL STANDARDS. Driscoll, R. L.; Olsen, P. T. (National Bureau of Standards, Washington, D. C.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 117-21(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Developments at Gaithersburg include compensation for earth's magnetic field variations and use of the method of nuclear induction to determine the precession frequency of protons in a magnetic field. Current procedures and recent results are presented. (auth)

26472 GYROMAGNETIC RATIO OF THE PROTON MEASURED IN A HIGH MAGNETIC FIELD. Kibble, B. P.; Hunt, G. J. (National Physical Lab., Teddington, Eng.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 131-5(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Measurements, using a prototype apparatus, of the force between a constant current in a coil with parallel vertical sides whose separation is changed by a known amount and a uniform horizontal magnetic field applied to the lower end are reported. Simultaneous observation of the precessional frequency of protons in water in the field yields the proton gyromagnetic ratio in the maintained NPL unit of current. Combining the result with that obtained by observing the precessional frequency in the field of a precision solenoid carrying a related current gives the currents and gyromagnetic ratio in absolute units. (auth)

26473 METHODS OF MEASURING THE MAGNETIC MOMENT OF THE PROTON IN TERMS OF THE NUCLEAR MAGNETON. Petley, B. W. (National Physical Lab., Teddington, Eng.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 159-67(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The methods used prior to 1970 to measure the magnetic moment of the proton in nuclear magnetons are reviewed. (auth)

26474 MAGNETIC MOMENT OF THE PROTON IN NUCLEAR MAGNETONS. Fystrom, D. O. (Wisconsin State Univ., La Crosse). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 169-72 (Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

A redetermination of μ'_p/μ_n using an omegatron similar to that of Sommer, Thomas, and Hipple is reported. Particular emphasis was placed on reducing rf field inhomogeneity and estimating the influence of surface potential variations. (auth)

26475 MEASUREMENT OF μ_p/μ_n. Petley, B. W.; Morris, K. (National Physical Lab., Teddington, Eng.). Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 173-5(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Recent measurements of μ_p/μ_n with a quadrupole omegatron are reported. The measurements were made at a flux density of 1.4 tesla and ions of mass 2, 3 and 4 were used to eliminate the shifts in the cyclotron frequency by electrostatic field gradients. The result of the present series of measurements is that μ_p/μ_n is 2.792828 ± 0.000023 (8.2 ppM) and 2.792754 ± 0.000023 (8.2 ppM) with and without the correction for the diamagnetism of water respectively. (auth)

26476 NOVEL-TYPE DETERMINATION OF THE MAGNETIC MOMENT OF THE PROTON IN UNITS OF THE NUCLEAR MAGNETON, μ_p/μ_n. Gubler, H.; Reichart, W.; Roush, M.; Staub, H.; Zamboni, F. (Univ., Zurich) Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 177-80(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Previous measurements of μ_p/μ_n were all based on the determination of the cyclotron frequency of protons circulating in a homogeneous magnetic field whose value was obtained through its proton nuclear spin resonance frequency. In the present experiment, the momentum of highly monochromatic protons (energy 1.3 MeV with less than 100 eV spread) is determined in a 180° magnetic spectrometer whose field is measured by its proton nuclear spin resonance frequency. The velocity of the protons is measured with the Los Alamos time of flight spectrometer through which the protons pass before entering the magnetic spectrometer. The results are expected to have an accuracy of at least 20 ppM. (auth)

26477 NEW TECHNIQUE FOR MEASURING THE CYLOTRON FREQUENCY OF IONS TO HIGH PRECISION. Luxon, James L.; Rich, Arthur (Univ. of Michigan, Ann Arbor). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 181-5(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

A new technique was developed for measuring ion cyclotron resonance. This technique may be applied to an accurate measurement of the magnetic moment of the proton in nuclear magnetons μ_p/μ_n as well as to ion mass ratios. The errors in applying this method should be different in character from those which occur in previous cyclotron resonance experiments. (auth)

26478 COMMENTS ON THE SOMMER, THOMAS, AND HIPPLE OMEGATRON MEASUREMENT OF μ_p/μ_n. Fystrom, D. O. (Wisconsin State Univ., La Crosse); Petley, B. W.; Taylor, B. N. Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 187-91(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The original data books pertaining to the Sommer, Thomas, and Hipple omegatron measurement of μ_p/μ_n were recently examined, and new information concerning the uncertainty to be assigned the experiment was found. (auth)

26479 MEASUREMENT OF h/m_e USING ROTATING SUPERCONDUCTORS. Parker, W. H.; Simmonds, M. B. (Univ. of California, Irvine). Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 243-8(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The fundamental constant h/m_e where m_e is the free electron

mass was determined from measurements on a rotating superconducting thin-film ring containing a single weak link. The value obtained agrees with the accepted value within the present uncertainty of 0.04 percent. (auth)

26480 MEASUREMENT OF THE COMPTON WAVELENGTH OF THE ELECTRON. Van Assche, P. H. M. (SCK/CEN, Mol, Belgium); Van den Cruyce, J. M.; Vandenput, G.; (and others). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 271-3(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Using a bent-crystal γ-diffraction spectrometer, the Compton wavelength of the electron was measured relative to the W $K\alpha_1$ wavelength (expressed in X-units). The annihilation line occurred in presence of the neutron-capture γ-ray spectra of Ta. The good resolution of the spectrometer allowed a discrimination against some capture γ lines superposed upon the annihilation line. The linearity of the spectrometer was checked with intense capture γ transitions, observed in different diffraction orders. With this technique a final precision of better than 30 ppM was obtained. The final value is $\lambda_c = 24.212\ 69 \pm 0.000\ 77$ XU, relative to $\lambda = 208.576\ 7 \pm 0.000\ 3$ XU for the wavelength of the $K\alpha_1$ x-ray of ^{182}W. (auth)

26481 MEASUREMENT OF THE MUON MAGNETIC MOMENT BY DOUBLE RESONANCE IN MUONIUM, AND A NEW VALUE OF ALPHA. Magnon, A.; DeVoe, R.; McIntyre, P. M.; (and others) (Univ. of Chicago). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 327-31(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Heretofore, any determination of α from the hfs splitting $\Delta\nu$ of muonium was severely limited by uncertainties in the published magnetic moment (not g-factor!) $\mu_\mu \equiv \mu_B g'_\mu$ s of the muon. Now μ_μ was determined from the frequencies of the two alternative Zeeman transitions $\nu_1(F = 1, M = 1 \leftrightarrow F = 1, M = 0)$ and $\nu_2(F = 1, M = -1 \leftrightarrow F = 0, M = 0)$ at that "magic" field B_0 (~11.35 kG) value where $\partial\nu_1/\partial B = \partial\nu_2/\partial B = 0$. At B_0 one has $(\nu_2 - \nu_1)/(\nu_2 + \nu_1) \equiv \nu_-/\nu_+ = 2[G(1 - G)]^{\frac{1}{2}}$, $G = -g'_\mu/(g_j - g'_\mu)$. Direct resonances in ν_- (or ν_+) were obtained by exciting the cavity simultaneously with ν_1 and ν_2 and keeping ν_+ (or ν_-) fixed. It is found that $g_j/g'_\mu = 206.76509\ (80)$, which with $g_j = g_e(1 - \alpha^2/3)$ corresponds to $f_\mu/f_p = 3.183373\ (13)$; pressure shifts of g_j are expected to be negligible. This result, combined with the best value for $\Delta\nu$ (extrapolated to zero pressure), yields $\alpha^{-1} - 137 = 0.03654\ (30)$ (2.0 ppM), in good agreement with the TPL recommended value 0.03602 (21). (auth)

26482 PRECISION MEASUREMENT OF THE MAGNETIC MOMENT OF THE MUON. Hague, J. F. (Univ. of Washington, Seattle); Rothberg, J. E.; Schenck, A.; (and others). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 333-6(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The ratio of muon to proton magnetic moment (μ_μ/μ_p) was measured to high precision in three chemical environments. The agreement shows that the "Ruderman correction" is not applicable. The result is $\mu_\mu/\mu_p = 3.183347(9)$ (2.8 ppM); in terms of the muon mass, this implies $m_\mu/m_e = 206.7683(6)$. (auth)

26483 MAGNETIC MOMENT OF THE POSITIVE MUON. Hutchinson, D. P. (Princeton-Pennsylvania Accelerator, N. J.); Larsen, F. L.; Schoen, N. C.; Sober, D. I.; Kanofsky, A. S. Contract AT(30-1)-3217. Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 337-8(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The magnetic moment of the positive muon was measured relative to that of the proton by determining its precession frequency in a magnetic field measured by proton NMR. With both protons and muons bound in a spherical sample of water, the result is $\omega_{\mu'}/\omega_{p'} = 3.183362 \pm 0.000030$ (9.4 ppM). Preliminary measurements of the muon precession frequency in cyclohexane and NaOH aqueous solution yield $[\omega_\mu(\text{cyclohexane}) - \omega_\mu(\text{NaOH})]/\omega_{p'} = 0.000039 \pm 0.000031 = 12.1 \pm 9.6$ ppM which is reasonably consistent with the difference of –3.6 ppM expected if the muon has the same relative chemical shifts as the proton. (auth)

26484 PROTON MOMENT IN BOHR MAGNETONS AND ALL THAT. Kleppner, Daniel (Massachusetts Inst. of Tech., Cambridge). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 411-16 (Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The gamesmanship of fundamental constants is explained. The tactics are elucidated by the presentation of a new value for the ratio of the proton moment to the electron moment in the ground state of hydrogen. Measurements were made with an atomic hydrogen maser. The result is $-\mu_e(H)/\mu_p(H) = 658.210\ 7061(65)$. (auth)

26485 PRELIMINARY RESULTS OF A NEW MEASUREMENT OF THE g-FACTOR ANOMALY OF THE FREE ELECTRON. Wesley, John C.; Rich, Arthur (Univ. of Michigan, Ann Arbor). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 437-42(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

A new measurement of the electron g-factor anomaly is reported. The preliminary result is $a = (1\ 159\ 644 \pm 7) \times 10^{-9}$, in good agreement with current QED theoretical predictions. The role of the constant μ'_p/μ_B (the magnetic moment of the proton in Bohr magnetons, measured in a water sample) in the experiment is discussed. The NMR techniques used to measure the magnetic field are detailed. (auth)

26486 MUON g-2 MEASUREMENT. Bailey, J. (CERN, Geneva). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 443-4 (Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The results of a recent experiment at CERN to measure the anomalous moment of the muon are summarized and compared with theory. New techniques now being implemented for improving the measurement are also noted. (auth)

Weak

Refer also to abstract 25674.

26487 (PITHA–57) RE-EVALUATION OF THE RELATIVE DECAY RATE OF LONG-LIVED AND SHORT-LIVED NEUTRAL KAONS INTO TWO NEUTRAL PIONS. Heeren, U. (Technische Hochschule, Aachen (West Germany). Physikalisches Institut (III)). 1972. 23p. Dep. NTIS (U. S. Sales Only).

Some time ago the CP-violating decay $K_L^0 \to \pi^0\pi^0$ was discovered by a CERN-RHEL-Aachen group, using a multiplate spark chamber arrangement near a K_L^0 beam, derived from the CERN proton synchroton. These data were reanalyzed performing a least squares fit to each event. The average errors of directions and energies of the detected photons were experimentally determined on samples of 4- and 6-shower events. A normalization on regenerated $K_S^0 \to 2\pi^0$-decays was used. The value of $|\eta_{00}| = |A(K_L^0 \to 2\pi^0)/A(K_S^0 \to 2\pi^0)| = (2.4 \pm 0.5) \times 10^{-3}$ is consistent with T violation and CPT conservation in $K_L^0 \to 2\pi$-decay and with the existence of a superweak interaction. (auth)

26488 SEARCH FOR THE DECAY $K^+ \to \pi^+\gamma\gamma$. Ljung, D. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Phys. Rev. Lett.; 28: No. 8, 523-6(21 Feb 1972).

A search was made for the rare decay mode $K^+ \to \pi^+\gamma\gamma$ by using a heavy-liquid bubble chamber. No events were found. A test was made of the Fujii model, which uses an off-mass-shell extrapolation of the $K_{\pi 2}$ amplitude to make predictions for this decay. The experimental upper limit on the branching ratio is reported to be 2.2×10^{-5}, and this result is inconsistent with the Fujii model. (auth)

26489 EXPERIMENTS ENVISAGED ON THE LEPTONIC DECAY OF HYPERONS. Sauvage, G. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 3, 27-32(1971). (In French).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). 1971).

Experiments envisaged on the leptonic decay of hyperons are described. Special attention is devoted to the new hyperon beams of CERN and the Brookhaven National Laboratory. (France)

26490 EXPERIMENTAL STUDY OF THE $K^+ \to \pi^+\pi^-e^+\nu$ DECAY. Basile, P. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 3, 45-52(1971). (In French).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

The results of an experimental sample of 637 $K^+ \to \pi^+\pi^-e^+\nu$ events are presented in the general framework of a review on the current experimental situation. These events were observed by the Geneva-Saclay collaboration using counter techniques. Statistics of sufficient quality to determine a unique solution for the form factors and the $\pi\pi$ phase shift in the region between 280 and 400 MeV are available. (France)

26491 EXPERIMENTAL TEST OF THE PARTIALLY CONSERVED AXIAL VECTOR CURRENT HYPOTHESIS. Masnou, J. L. (Ecole Normale Superieure, Orsay, France). J. Phys. (Paris), Colloq.; No. 3, 117-21(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

The partially conserved axial current hypothesis (PCAC) can be checked for inelastic neutrino interactions for small values of q^2 (square of leptonic transfer quadrivector). It relates the differential cross section of the $\nu_\mu + \alpha \rightarrow \mu^- + \beta$ reaction to the $\pi^+ + \alpha \rightarrow \beta$ cross section for the same hadronic mass, M_β. It is demonstrated that the experimental results are in agreement to within one standard deviation with predictions mode using PCAC, for $q^2 < 0.12$ GeV/c. It is shown that, in particular, the correction due to the transverse weak current component, estimated by the vector dominance model, is significant. (France)

26492 TEST OF THE DELTA-S EQUALS DELTA-Q SLECTION RULE IN K-ZERO MESON DECAYS TO PION MUON NEUTRINO. Graham, Michael Francis. Urbana, Ill.; Univ. of Illinois (1971). 135p. University Microfilms Order No. 72-6936.

Thesis.

An experiment was performed at the Argonne National Laboratory ZGS to test the $\Delta S = \Delta Q$ selection rule in $K^0_{\mu 3}$ decay. The theoretical time distribution for $K^0_{\mu 3}$ decays contains a complex parameter x'. A nonzero value of x' implies a violation of the $\Delta S = \Delta S$ rule, and a nonzero value of Im(x') implies a violation of CP symmetry. K^0's were obtained from 3.0-GeV/c negative pions striking a carbon target giving the reaction $\pi^- p \rightarrow \Lambda K^0$. Counters, optical spark chambers, and a spectrometer magnet were used to record $K^0_{\mu 3}$ decays on film for reconstruction on a computer. The detection of the proton from $\Lambda \rightarrow \pi^- p$ was used as a trigger requirement to indicate associated production of the K^0. The muon from the $K^0_{\mu 3}$ decay was detected by counters placed behind a steel absorber used to suppress $K^0_{\pi 2}$ background. A sample of $K^0_{\mu 3}$ events decaying between 0.5 and 6.5 K^0_S lifetimes was obtained. A fit to the data with the theoretical time distribution corrected for experimental detection efficiency was made. Maximum likelihood was used to obtain the best estimators of the parameters Re(x') and Im(x') of the theoretical distribution. The results obtained for 100 events were: $\mathrm{Re}(x') = .04^{+.18}_{-.17}$, $\mathrm{Im}(x') = .12^{+.21}_{-.19}$. These results are consistent with the $\Delta S = \Delta Q$ rule and CP symmetry. (Diss. Abstr. Int., B)

26493 SEARCH FOR VIOLATION OF CP INVARIANCE IN THE DECAY OF K^+-MESONS INTO THE tau MODE. Souder, Paul Allen. Princeton, N. J.; Univ. of Princeton (1971). 183p. University Microfilms Order No. 72-2752.

Thesis.

In a search for violation of CP invariance in τ decay the Dalitz-plot distributions of 1.6 million τ^+ decays ($K^+ \rightarrow \pi^+\pi^+\pi^-$) and an equal number of τ^- decays ($K^- \rightarrow \pi^-\pi^-\pi^+$) were compared. This experiment was performed in a 3-GeV/c partially separated beam at the Brookhaven AGS. Kaons decaying into three pions were detected by a threefold coincidence in an eight-counter hodoscope. The directions of all three pions were measured in a set of five wire spark chambers, and a wide-aperture spectrometer magnet and six more wire spark chambers served to determine the momentum of the odd pion. The data were taken and analyzed in exactly the same way for both positive and negative beams. Numerous checks were made to ensure that the apparatus treated both decays identically. No statistically significant difference was found between τ^+ and τ^- decay in any region of the Dalitz plot. In terms of the slope parameters a^+ and a^- for the odd pion energy spectra in the rest frame of the kaon, the asymmetry is: $\Delta = (a^+ - a^-)/(a^+ + a^-) = -0.0070 \pm 0.0053$. These results are consistent with no CP violation in τ decay. (Diss. Abstr. Int., B)

26494 METHODS FOR LEPTON g-FACTOR ANOMALY MEASUREMENTS. Graeff, G. (Univ., Mainz). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 431-5(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The experimental methods are described which so far were used in lepton g-factor measurements. In particular, the advantages and disadvantages of the different methods are compared and the question of whether the accuracy of these experiments can be improved is discussed. (auth)

Strong (Baryon-induced)

Refer also to abstract 26853.

26495 (JINR-P1-6244) INVESTIGATION OF ELASTIC p-d SCATTERING IN DIFFRACTION CONE REGION FROM 10 TO 70 GeV. Bartenev, V. D.; Beznogikh, G. G.; Buyak, A.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). Feb 1972. 6p. (In Russian). Dep. NTIS (U. S. Sales Only).

The results are presented of measurements of the slope parameter for diffraction cone b and of the ratio (a) of the real part of p-d elastic scattering amplitude to imaginary one at the value of the four-momentum square $|t| < 0.2$ (GeV/c)^2. It is shown that b increases in value, a changes from -0.29 ± 0.05 to -0.14 ± 0.05 in the energy interval 10 to 70 GeV. The experiment is performed at the IHEP accelerator (Serpukhov). (auth)

26496 (JINR-P1-6246) INVESTIGATION OF AN ELASTIC p-p SCATTERING IN THE INTERFERENCE REGION OF THE COULOMB AND NUCLEAR INTERACTIONS FROM 8 TO 70 GeV. Bartenev, V. D.; Beznogikh, G. G.; Buyak, A.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). Feb 1972. 35p. (In Russian). Dep. NTIS (U. S. Sales Only).

The measurement results are presented for an elastic p-p scattering in the interference region of the Coulomb and nuclear interactions $(0.0007 \leq |t| \leq 0.02$ (GeV/c)^2 in the energy range 8 to 70 GeV. Measurements were performed at the Serpukhov accelerator. It is shown that the value a (a is the ratio of the real part of the elastic p-p scattering amplitude to the imaginary one at t = 0) changes in this energy range from -0.35 ± 0.05 at the momentum p = 9.39 GeV/c to -0.092 ± 0.011 at p = 69.8 GeV/c, it agrees with the results of calculations performed on the basis of dispersion relations with one subtraction. The method of measuring and analyzing the experimental data is described. Use of the hydrogen jet as an internal target of the accelerator differs in this experiment from the previous one in which the slope parameter of the elastic p-p scattering differential cross section was measured in the same energy range. (auth)

26497 COHERENT PRODUCTION OF PARTICLES IN HADRON-NUCLEUS SCATTERING (EXPERIMENTAL). Bingham, H. H. (Univ. of California, Berkeley). Acta Phys. Pol.; B3: No. 1, 31-81(Jan-Feb 1972).

Data are reviewed on coherent production reactions from nuclei in π, K, nucleon and antinucleon beams of momenta above ~2 GeV/c. Characteristics of the dominant ("vacuum exchange") reactions and rarer ("ω exchange") reactions are summarized. (auth)

26498 EVIDENCE FOR RAPIDLY RISING p-p TOTAL CROSS SECTION FROM COSMIC-RAY DATA. Yodh, G. B. (Univ. of Maryland, College Park); Pal, Yash; Trefil, J. S. Phys. Rev. Lett.; 28: No. 15, 1005-8(10 Apr 1972).

Estimates of lower bounds on the p-p total cross section are given based on cosmic-ray data. It is found that σ_{pp} rises at least as rapidly as $38.8 + 0.4 \ln^2(s/s_0)$ from $E \sim 10^3$ to 3×10^4 GeV incident energy, corresponding to $\sigma_{pp} \geq 60$ mb at the highest energy available. In view of large experimental errors at the highest energies, a value of $\sigma_{pp} \geq 48$ mb can be estimated at 95% confidence level $E \sim 10^4$ GeV. (auth)

26499 FIZIKA VYSOKIKH ENERGII I KOSMICHESKIKH LUCHEI. (High Energy Physics and Cosmic Radiation). Shevchuk, T. I. (ed.). Alma-Ata, USSR; Izdatel'stvo Nauka Kazakhskoi SSR (1971). 268p.

This collection of 12 papers presents surveys of specific subjects related to high energy physics. Data taken from the literature on pion-nucleon and nucleon-nucleon interactions (at 10 to 76 GeV, for example) in an accelerator are analyzed. Data on 200-GeV cosmic ray interaction with materials are similarly summarized. Most papers are concerned with inelastic interactions (p-n, π-mesons-nucleons), however some bubble chamber and spark chamber work is discussed, and μ-meson fluxes at an altitude of 1,700 m are examined. (K.S.W.)

26500 RESONANCE PRODUCTION IN $\bar{p}$-n INTERACTION AT 3.5 GeV/c. Hsieh, J. S.; Munir, B. A. (Ohio Univ., Athens). Particles Nucl.; 1: No. 4, 275-86(Jan 1971).

Preliminary results are presented for $\bar{p}$-n interactions at 3.5 GeV/c resulting in three charged secondaries. In the nonannihilation channels, the reactions are dominated by a strong anti-isobar formation. There is also evidence for the formation of a heavy boson of mass nearly 2.6 GeV. Annihilation reactions producing η^0 are isolated to study $\eta\pi$ and $\eta\pi\pi$ systems for possible bumps. These results are very preliminary. (auth)

26501 FORMATION STUDY OF $\bar{p}p$ INTERACTIONS THROUGH THE T-MESON REGION. Donald, R. A. (Univ. of Liverpool);

Edwards, D. N.; Howard, D.; (and others). Particles Nucl.; 1: No. 2, 105-16(Nov 1970).

Progress is reported on a study of differential and total cross sections for backward and forward elastic scattering, cross sections for single pion production, and total and differential cross sections for annihilation into $\pi^+\pi^-$ and K^+K^- for p + p interactions at 1.23 to 1.43 GeV/c in hydrogen bubble chamber. (J.F.P.)

26502 BOSON FORMATION IN $\bar{N}N$ FORMATION EXPERIMENTS IN THE T- AND U-MESON REGIONS. Smith, Gerald A. (Michigan State Univ., East Lansing). Particles Nucl.; 1: No. 2, 117-24(Nov 1970).

Recent developments for strong interactions in the region of the T and U mesons are reviewed. (J.F.P.)

26503 HIGH MULTIPLICITY $\bar{N}N$ ANNIHILATIONS AT HIGH ENERGIES. Ijaz, M. A. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Munir, B. A. Particles Nucl.; 1: No. 2, 153-62(Nov 1970).

Some features of the high multiplicity annihilations in $\bar{N}N$ experiments below 10 GeV/c are discussed. Reported are also some preliminary data from the $\bar{p}d$ exposure at 3.5 GeV/c for five prong events. Transverse and longitudinal momentum spectra of the pions produced in annihilations are analyzed in terms of statistical, thermodynamical, two temperature and CLA models. Dependence of a new variable $\langle|P_l|\rangle/E_{c.m.}$ on multiplicity is discussed. (auth)

26504 PARTICLE PRODUCTION FROM DEUTERONS OF 1.16 AND 1.62 GeV. Oostens, Jean; de Sereville, Bernard (CEN, Saclay, France). Particles Nucl.; 1: No. 5, 309-20(Feb 1971).

A beam survey of secondary particles produced from internal targets at 15° was conducted, using the newly developed deuteron acceleration capabilities of the synchrotron Saturne. Besides providing interesting information for experimental planning, the measurements yield a rough test of charge symmetry in π^+ and π^- production. Other features observed include a proton peak attributed to stripping of the incident deuteron, abundant production of tritons, and observation of a peak in the deuteron spectrum corresponding to the reaction D + P = D + P from a polyethylene target. (auth)

26505 STUDY OF FIVE PRONG $\bar{p}n$ ANNIHILATIONS AT 3.5 GeV/c. Ijaz, M. A. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Munir, B. A. Particles Nucl.; 3: No. 3, 157-63 (Mar 1972).

Some preliminary results are presented for $\bar{p} + n \rightarrow 3\pi^- + 2\pi^+$, $\bar{p} + n \rightarrow 3\pi^- + 2\pi^+ + \pi^0$ (η^0) interactions at 3.5 GeV/c in a deuterium bubble chamber. The angular and momentum distributions of the charged pions are shown. Both transverse and longitudinal momentum spectra are given. (J.F.P.)

26506 Λ^0 AND $\Lambda^0-\gamma$ PRODUCTION IN 24.9 GeV/c AND 28.6 GeV/c PROTON-PROTON INTERACTIONS. Lee, Jeffrey John. New Brunswick, N. J.; Rutgers-The State Univ. (1971). 171p. University Microfilms Order No. 72-9637.

Thesis.

Neutral strange particle events, with and without associated gamma conversions, produced through 24.9 and 28.6-GeV/c proton-proton interactions in the Brookhaven National Laboratory 80″ hydrogen filled bubble chamber were analyzed. The major purposes of this experiment were to search for possible new resonances, especially for Λ^*'s which would decay by $\Lambda^* \rightarrow \Lambda^0 + \gamma$, and would not have been easily observed in earlier experiments with much poorer resolution; to determine which, if any, charged Y^*'s and K^*'s are important to neutral strange particle production; to gather data on inclusive reactions at the highest energy available, permitting comparisons with earlier results at lower energies and future results at much higher energies, thus providing the empirical foundation for a reliable theory of particle production. Only neutral strange particles and charged particles identifiable without complete fits were analyzed in this experiment. Λ^0's, Λ^0's, and K^0's were reliably identified by fitting to their decay particles. Protons were identified by ionization, and π^-'s by association with Λ^0's. Enriched samples of $K^\pm$ and $\pi^\pm$ were obtained through kinematic cuts. Resolution of the invariant mass of $\Lambda^0-\gamma$ was better than 5 MeV for masses below 1400 MeV. The cross section for Σ^0 production was (6.5 ± 3.0)% of the total Λ^0 cross section; no evidence of $Y^*(1330)$ production was found. The production of $\Sigma^{*+}(1385)$ and $K^{*+}(892)$ was large, while there was no evidence of Σ^{*-} or K^{*-} production. The distribution of the Λ^0-p invariant mass suggested a small effect, similar to that seen in earlier experiments. No other mass distributions showed any appreciable effects. In addition to mass distributions, several inclusive single particle distributions and averages suggested by various theories of limiting behavior at infinite energy were obtained to permit comparison with other experiments at different energies. (Diss. Abstr. Int., B)

26507 SEARCH FOR MAGNETIC MONOPOLES AT THE 70 GeV IHEP PROTON SYNCHROTON. Gurevich, I. I. (Inst. of Atomic Energy, Moscow); Khakimov, S. Kh.; Martemyanov, V. P.; (and others). Phys. Lett.; 38B: No. 7, 549-50(3 Apr 1972).

The result of a search for magnetic charged particles at 70 GeV IHEP proton synchrotron is presented. Using the ferromagnetic trap method the upper limit of the magnetic monopole production cross section in proton-nucleon collisions was found to be $\sigma(95\%) \geq 1.4 \times 10^{-43}$ cm^2. (auth)

26508 SOME PROPERTIES OF NUCLEAR INTERACTION OBTAINED WITH AN IONIZATION SPECTROMETER AT PROTON ENERGIES FROM 10 TO 28 GeV. Jones, W. V. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.); Pinkau, K.; Pollvogt, U.; Schmidt, W. K. H.; Huggett, R. W. Nuovo Cim.; 8A: No. 3, 575-91(1 Apr 1972).

Results on the inelasticities and inelastic cross section of proton interactions in carbon, iron and lead in the energy range from 10 to 28 GeV are presented. These results were obtained from data taken at the Brookhaven Alternating Gradient Synchrotron during the energy calibration of apparatus consisting of spark chambers, target material and an ionization spectrometer. Some problems and advantages in the use of this apparatus are discussed. The average total inelasticity $\bar{K}$ for proton interactions in carbon, iron and lead is compared with results from other work at higher energies. It appears that $\bar{K}$ has little dependence on primary energy, but it does depend somewhat on atomic mass number A of the target material. The effective nucleon-nucleon cross section was deduced from the measured inelastic cross sections in carbon, iron and lead assuming an A_s cross-section dependence. The result is consistent with the average value of (44 ± 6) mb obtained from other measurements made over a wide range of energies. (auth)

26509 $\bar{P}P$ INTO $\pi^+\rho^-$ AT SMALL ANGLES BETWEEN 1 AND 2 GeV/c. Yoh, J. K. (California Inst. of Tech., Pasadena); Atwood, W.; Barish, B.; (and others). Particles Nucl.; 1: No. 2, 125-30(Nov 1970).

The process $\bar{p}p$ into π^+ and $(MM)^-$ was studied using wire spark chambers. The data cover the angular range of cos $\theta^*(\bar{p}\pi^+)$ between 0.96 and 1.0 at several incident momenta between 1 and 2 GeV/c. The reaction $\bar{p}p \rightarrow \pi^+\rho^-$ was observed with $d\sigma/d\Omega^*$ of the order of 100 μb/sr at several momenta. (auth)

Strong (Meson-induced)

26510 (COO-1195-218) COHERENT PRODUCTION OF THE KAON, PION, PION SYSTEM BY POSITIVE 3.8 GeV/c KAONS ON DEUTERIUM. Robinson, Michael Ray (Illinois Univ., Urbana). Oct 1971. 143p. Dep. NTIS.

Thesis.

A study of coherent $K\pi\pi$ production by 3.8-GeV/c K^+ particles in the deuterium filled Argonne 30″ bubble chamber is presented. The study is based on 934 events of the reaction $K^+d \rightarrow dK^+\pi^+\pi^-$ and 337 events of the reaction $K^+d \rightarrow dK^0\pi^+\pi^0$. Features of the $dK^+\pi^+\pi^-$ final state are compared with the distributions expected for pion exchange production of the $K^*(890)$ meson. Events associated with a 93-MeV/c^2 wide peak at 1.29 GeV/c^2 in the $K^+\pi^+\pi^-$ mass spectrum are investigated. Evidence that the narrow peak is due to resonance production is presented. There is enough evidence for resonance production so that the idea is tantalizing if not conclusive. The general features of both the reaction $K^+d \rightarrow dK^+\pi^+\pi^-$ and $K^+d \rightarrow dK^0\pi^+\pi^0$ are also presented. (auth)

26511 (FRNC-TH-168) STUDY OF THE FORWARD PRODUCTION OF VECTOR MESONS IN ASSOCIATION WITH A BARYON IN PSEUDOSCALAR MESON-NUCLEON INTERACTIONS AT 3 GeV/c. Lamidey, Gilles (Paris Univ., Orsay (France). Faculte des Sciences). 1971. 162p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The K^- deuterium reaction at 3 GeV/c was studied experimentally. The total cross sections of the different final states and the angular distributions and spin density matrices for vector meson production reactions were obtained. It was verified that as in almost all two-body or quasi two-body reactions at high energy, where the formation of a particle or a known resonance is possible in the crossed channel, the $K^-n \rightarrow \rho^0\Sigma^-$, $\omega\Sigma^-$, $\varphi\Sigma^-$ reactions present a forward peak in the angular distribution associated with the production. These reactions and other $0^-\frac{1}{2}^+ \rightarrow$

$1^-1/2^+$ reactions are interpreted by a Regge pole exchange model assuming coupling constants which satisfy the relations imposed by SU(3) symmetry. The results of six fits, corresponding to different hypotheses on the residues, with experimental data from 11 reactions, are presented. (France)

26512 (JINR-P1-6277) MULTIPLICITY DISTRIBUTIONS IN π^-p, π^-n, AND π^-C INTERACTIONS AT 40 GeV/c. Abdurakhimov, A. U.; Angelov, N.; Belyakov, V. A.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

The results are presented on multiplicity of charged particles produced in π^-p, π^-n and π^-C interactions at the momentum pc = 40 GeV/c. The dependence of the average number of γ-quanta on the number of charged particles in π^-p and π^-n collisions is also given. (auth)

26513 (SLAC-142) STUDY OF $\pi^-p \rightarrow \pi^+\pi^-n$, K^+K^-n AT 15 GeV/c AND A COMPARISON WITH ABSORPTIVE ONE-PION-EXCHANGE. Williams, Hugh H. (Stanford Linear Accelerator Center, Calif.). Jan 1972. Contract AT(04-3)-515. 210p. Dep. NTIS.

Thesis.

Results are reported from a wire spark chamber experiment performed at the Stanford Linear Accelerator Center to study the production of $\pi^+\pi^-n$ final states in 15 GeV/c π^-p interactions. Approximately 10,000 $\pi^+\pi^-n$ events were detected with a $\pi\pi$ mass less than 1.0 GeV and a momentum transfer to the nucleon less than 0.3 $(GeV/c)^2$. The differential cross section and density matrix elements of the dipion system were determined as a function of momentum transfer for events with a $\pi\pi$ mass in the interval 0.665 to 0.865 GeV. Many of the density matrix elements in the helicity frame are observed to exhibit structure for momentum transfers less than m_π^2. In particular, there is a pronounced dip in the value of $\rho_{00}-\rho_{11}$ which has not been previously observed. The interference terms, $Re\rho_{0s}$ and $Re\rho_{1s}$, exhibit similar shape and change sign at momentum transfers equal to m_π^2. The longitudinal and total differential cross sections also decrease rapidly in the forward direction, while the cross section for transversely polarized rho mesons exhibits a sharp rise analogous to that observed in single-pion photoproduction. Each of the qualitative features is correctly predicted by OPEA, and a five-parameter fit of the model to the data quantitatively reproduces all of the observed structure. It is therefore concluded that the model provides a rather good explanation of this reaction at small momentum transfers. In addition to the $\pi^+\pi^-n$ events, K^+K^-n and $p\bar{p}n$ states were also detected and identified by a Čerenkov counter. The production of ϕn events which subsequently decay into K^+K^-n is observed to proceed with a cross section of 65 ± 26 μb. No sharp structure is observed in the $p\bar{p}$ mass spectrum, but this final state is produced with a relatively large cross section; the ratio of $p\bar{p}n$ to K^+K^-n final states is approximately 1 : 1. (auth)

26514 REACTION $\pi^+p \rightarrow \Delta^{++}A_2^0$ AT 3.7 GeV/c. Barnham, K. W. J.; Abrams, G. S.; Butler, W. R.; (and others) (Univ. of California, Berkeley). Particles Nucl.; 1: No. 2, 163-8(Nov 1970).

Some preliminary results are reported for A_2 production in $\pi^+ + p \rightarrow p + 2\pi^+ + \pi^- + \pi^0$ interactions at 3.7 GeV/c. The differential cross sections for events in the A_2^0 region and the Δ^{++} band are shown. Narrow A_2^0 signals are found at mass = 1297 ± 4 MeV and width = 48 ± 15 MeV and at mass = 1317 ± 6 MeV and width = 50 ± 26 MeV. (J.F.P.)

26515 MULTIPERIPHERAL ANALYSIS OF THE REACTION $\pi^+d \rightarrow p_sp\pi^+\pi^-\pi^0$ AT 13 GeV/c. Barton, H. R. Jr.; Badewitz, R. C.; Miller, D. H.; (and others) (Purdue Univ., Lafayette, Ind.). Particles Nucl.; 1: No. 3, 198-208(Dec 1970).

The reaction $\pi^+d \rightarrow p_sp\pi^+\pi^-\pi^0$ was studied at 13 GeV/c incident π^+ momentum in a 260,000 picture exposure taken in the 82'' deuterium bubble chamber at the Stanford University Linear Accelerator. The data are characterized by meson charge exchange, i.e., a neutral pion is produced at low momentum transfer relative to the π^+ beam. This characteristic of the reaction plus charge exchange at the nucleon vertex prohibit Pomeranchuk exchange. A triple-peripheral model which is capable of reproducing the data is discussed. The momentum transfer and effective mass distributions observed in this experiment are compared with model calculations. (auth)

26516 OMEGA PRODUCTION IN π^+p INTERACTIONS AT 2.67 AND 2.30 GeV/c. Ko, Winston Tai-kan. Philadelphia; Univ. of Pennsylvania (1971). 120p. University Microfilms Order No. 72-6183.

Thesis.

The analysis of 50,000 four-prong events from 500,000 pictures taken in the LRL 25-inch bubble chamber is presented. An automatic event identification scheme is devised utilizing both the kinematic χ^2 and the ionization information given by the flying spot digitizer which measures the film. The events with the final state $\pi^+\pi^+\pi^-\pi^0p$ are fitted to $\omega\pi^+p$ by constraining one set of $\pi^+\pi^-\pi^0$ to be the ω. The ω-signal in the sample is better than 6 to 1 above the background. The general features of the $\pi^+p\omega$ system were studied. It was found that the system is dominated by $\Delta^{++}(1236)$ production (50% for 2.67 GeV/c and 60% for 2.30 GeV/c). A weak B signal is observed in the $\pi^+\omega$ mass distribution. A detailed study of the reaction $\pi^+p \rightarrow \omega\Delta^{++}$ was made. Model independent parameters of differential cross section and the decay density matrix elements in both the s-channel and t-channel helicity frames are presented. From the information of the decay density matrix element of the omega in the t-channel helicity frame it is concluded that the reaction $\pi^+p \rightarrow \omega\Delta^{++}$ cannot be explained by single particle exchange. However, a mechanism to separate the exchanges according to their spin-parity is also presented. Using this mechanism one can obtain the ρ-trajectory. The effective B-trajectory obtained passes through the B meson mass. Comparison of the data to the quark model is also made. The class A and B relations given by Bialas and Zalewski are well satisfied while the class C relation fails. (Diss. Abstr. Int., B)

26517 STUDY OF THE OMEGA-ZERO SPIN-DENSITY MATRIX ELEMENTS IN THE REACTION PI-MINUS PROTON GOES TO OMEGA-ZERO NEUTRON AT 3.65, 4.5, and 5.5 GeV/c. Rosenberg, Eli Ira. Urbana, Ill.; Univ. of Illinois (1971). 107p. University Microfilms Order No. 72-7041.

Thesis.

A study was made of the ω^0 spin-density matrix elements in the reaction $\pi^-p \rightarrow \omega^0n$. The data were collected using a combination of scintillation counters and optical spark chambers designed to detect events of the type $\pi^-p \rightarrow \pi^+\pi^-\gamma\gamma n$. Incident pions of momenta 3.65, 4.5, and 5.5 GeV/c were produced by an internal target at the Argonne National Laboratory Zero Gradient Synchrotron. The values obtained for the ω^0 spin-density matrix elements are inconsistent with the predictions of a simple model which allows for Reggeized $\rho(765)$ and B(1235) exchange. (Diss. Abstr. Int., B)

26518 ANALYSIS OF TWO-PRONGED EVENTS FROM 4.1 GeV/c π^+p INTERACTIONS. Pitluck, Samuel. Providence; Brown Univ. (1971). 122p. University Microfilms Order No. 72-8161.

Thesis.

The two-pronged events from a 100,000 picture exposure of the Argonne-MURA 30'' hydrogen bubble chamber to a 4.1-GeV/c π^+-beam were analyzed. The cross sections for 2-, 4-, and >4-pronged events were determined. They agree with previous measurements at 3.9 and 4.0 GeV/c. The cross sections for the various two-pronged channels were also determined. The π^+p elastic scattering is seen to be very peripheral. Also, evidence is seen for backward elastic scattering. Using a simple optical model, the radius of the interaction was calculated to be 1.03 fermis. The remaining two-pronged channels were investigated for resonance production. In the $p\pi^+\pi^0$ channel, there was ample production of ρ^+ (765) and $N^{*++}(1236)$ in the $(\pi^+\pi^0)$ and $(p\pi^+)$ spectra, respectively. There was some enhancement seen in the combined $(\eta\pi^+)$ and $(\rho\pi^0)$ spectra around 1.4 GeV/c^2. Also, the $N^{*++}(1236)$ was observed in the $p\pi^+$ MM channel and there was clear evidence for the production of the η^0 and ω^0 in the missing mass spectrum. There was some evidence for the production of the A_2^+ in the (π^+MM) spectrum. The differential cross sections and the spin-space density matrix elements were calculated for the ρ^+ and N^* samples. A comparison was made with the absorption model of Dar, Watts, and Weisskopf as well as with a Regge-pole model of Krammer and Maor. Finally, an attempt was made to fit the data from the $p\pi^+\pi^0$ channel using a new multi-Regge peripheral model. The model gave very good predictions for the angular distributions, momentum distributions, and invariant mass distributions. (Diss. Abstr. Int., B)

26519 STUDY OF HIGH MASS BOSON STRUCTURES IN π^+p INTERACTIONS AT 13.1 GeV/c. Kramer, S. L.; Barton, H. R. Jr.; Ezzell, C. R.; (and others) (Purdue Univ., Lafayette, Ind.). Particles Nucl.; 1: No. 2, 131-40(Nov 1970).

Results are presented on the production of high-mass bosons in π^+ + p interactions at 13.1 GeV/c. The observed structures are compared with the boson states observed in missing-mass and $\bar{p}p$ experiments. In addition the one charged particle and the $\pi^+\pi^0$ decay modes are studied in some detail. (auth)

26520 f^0 RESONANCE PRODUCTION IN π^+d INTERACTIONS AT 5.1 AND 9 GeV/c. Fogli-Muciaccia, M. T.; Picciarelli, V. (Univ., Bari, Italy. Istituto Nazional di Fisica Nucleare, Bari, Italy). Nuovo Cim.; 8A: No. 3, 670-84(1 Apr 1972).

A study on the f^0 resonance production and decay in two experiments of π^+d at 5.1 and 9 GeV/c is reported. The results are interpreted with the aid of Wolf's modified OPE model. (auth)

26521 IS THERE STRUCTURE IN THE f^0 MASS REGION? Kemp, D. (Durham Univ., Eng.); Major, J. V.; Scarrott, S. M.; (and others). Nuovo Cim.; 8A: No. 3, 611-20(1 Apr 1972).

Evidence is presented for structure in the f^0-mass region in the reaction $\pi^+n \rightarrow p\pi^+\pi^-$ at a pion momentum of 11.7 GeV/c. A detailed analysis indicates that it is most unlikely that the structure is a statistical effect. (auth)

26522 STUDY OF $\pi^+\pi^-$ SCATTERING IN $\pi^-p \rightarrow \pi^+\pi^-X^0$ VIA A CHEW LOW EXTRAPOLATION. Baillon, P.; Carnegie, R. K.; Kluge, E. E.; (and others) (Stanford Univ., Calif.). Phys. Lett. 38; B: No. 7, 555-9(3 Apr 1972).

An unconstrained Chew–Low extrapolation was performed using 50 000 events from the reaction $\pi^-p \rightarrow \pi^+\pi^-X^0$ at 15 GeV/c, with $-t < 0.3$ $(GeV/c)^2$. An energy independent phase shift analysis was performed. Results on the $\pi\pi$ cross section, p-wave and s-wave phase shifts in the mass range (525-975) MeV are presented. A unique solution was found for the s-wave phase shift below 750 MeV. (auth)

26523 $K^0\Delta^{++}(1236)$ PRODUCTION IN K^+p SCATTERING BETWEEN 0.9 AND 1.5 GeV/c. Griffiths, F. (Univ. of Glasgow); Hirata, A.; Hughes, I. (and others). Nucl. Phys.; B38: No. 2, 365-74(1972).

Data are presented on the quasi two-body reaction $K^+p \rightarrow K^0\Delta^{++}(1236) \rightarrow K^0p\pi^+$ in the momentum range 0.9 to 1.5 GeV/c. The data was used in an energy-dependent partial wave analysis of the above reaction. The solutions obtained in this analysis do not require the formation of an exotic resonance ($Z\uparrow$) in the s-channel. (auth)

26524 DOUBLE REGGE EXCHANGE MODEL ANALYSIS OF QUASI-THREE-BODY FINAL STATES IN 7 GeV/c, π^-p INTERACTIONS. Chien, C. Y. (Johns Hopkins Univ., Baltimore); Chao, A. C. L.; Johnston, T. F.; (and others). Particles Nucl.; 2: No. 2, 74-92(Aug 1971).

The double Regge exchange model of Berger is used to fit quasi-three body final state reactions $\pi^-p \rightarrow \rho^0\pi^-p$, $f^0\pi^-p$, and $\pi^-\pi^-\Delta^{++}$ observed in $\pi^-p \rightarrow p\pi^+\pi^-\pi^-$ events from a 7 GeV/c π^-p experiment. Good agreements are obtained in all mass and angular distributions with a single set of Regge parameters. Overall normalizations are also obtained by taking limits of OPE and diffraction scattering approximation. (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 26406.

General

Refer also to abstracts 26718 and 26762.

26525 (ORO-3992-64) "GOLDEN AGE OF THEORETICAL PHYSICS": P.A.M. DIRAC'S SCIENTIFIC WORK FROM 1924 TO 1933. Mehra, Jagdish (Texas Univ., Austin. Center for Particle Theory). Feb 1972. Contract AT(40-1)-3992. 88p. (CPT-114). Dep. NTIS.

The intellectual background of Dirac and his contributions to theoretical physics during the time from 1924 to 1933 are discussed. (J.F.P.)

26526 MODEL FOR DIFFRACTIVE PRODUCTION OF PARTICLES IN HIGH-ENERGY COLLISIONS. Bialas, A. (Jagellonian Univ., Krakow. Inst. of Nuclear Physics, Krakow). Acta Phys. Pol.; B3: No. 1, 21-9(Jan-Feb 1972).

The general ideas of the Good and Walker diffraction dissociation mechanism are reviewed and a proposal of a specific realization of these ideas is presented. The model, developed by Czyż, Kotański and myself, is based on the idea that the interacting particles should be considered as fluctuating objects. During the collision process these virtual fluctuations become real observable states. Thus, the model can be viewed as a generalization of the vector dominance model of ρ photoproduction. The model explains all essential features of diffractive production and it provides many important tests, particularly for the diffractive production from nuclei. (auth)

26527 UR-CITON: AN ATTEMPT FOR UNIFIED THEORY OF HADRONS. Ishida, Shin (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1905-23(Dec 1971).

An explicit form of interaction Hamiltonian in the unified ur-citon space is deduced. Application to strong, electromagnetic, and weak interactions of hadrons is discussed. (L.B.S.)

26528 CRITERION FOR THE PHYSICAL INTERPRETION OF MINIMAL AND NONMINIMAL INTERACTIONS. Barut, A. O. (Univ. of Colorado, Boulder); Malin, S. Ann. Phys. (N. Y.); 69: No. 2, 463-72(Feb 1972).

A classification of currents for finite- and infinite-component wave equations is proposed depending on their algebraic and convective nature. Algebraic terms with a consistent one-particle interpretation constitute the minimal interactions. The nonminimal interactions are interpreted as effective c-number currents describing many particle effects and/or composite structures. A number of applications are treated. (auth)

26529 LAPLACE TRANSFORM DIAGONALIZATION OF FORWARD SCATTERING ABSORPTIVE PART EQUATIONS. Abarbanel, Henry D. I.; Saunders, L. M. (Princeton Univ., N. J.). Contracts AT(30-1)-4159; AF 49(638)-1545. Ann. Phys. (N. Y.); 69: No. 2, 583-603(Feb 1972).

A Laplace transform procedure is presented for the partial diagonalization of Bethe–Salpeter-like absorptive part equations for the forward scattering of spinning particles. By using Laplace transforms the analysis allows directly for power growth in energy of the absorptive parts of the amplitude without any need for the analytic continuations required in a Fourier analysis. The integral equation with an arbitrary kernel is explicitly diagonalized, resulting in a reduction from a set of four-dimensional equations to coupled one-dimensional equations. As a tool for locating the proper definitions of partial wave amplitudes and for deriving a crucial addition theorem, the necessary representation theory of the little group for forward scattering, SO (1,3), is described. (auth)

26530 MULTIPARTICLE SUM RULES. Weinberg, Steven (Masachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 5: No. 4, 900-12(15 Feb 1972).

Sum rules are derived by applying soft-pion theorems to the dispersion relations for the reactions $\pi + I \rightarrow \pi + F$, $I \rightarrow 2\pi + F$, $2\pi + I \rightarrow F$, with I and F general multiparticle states. In the special case where I contains one particle and F contains two particles, these sum rules have a simple algebraic interpretation: They require that the transition matrix elements for reactions $\pi + I \rightarrow F$ or $I \rightarrow F + \pi$ can receive contributions only from the representations (A,B) of chiral SU(2) ⊗ SU(2) with A = B, but not A = B ± 1. Prescriptions are given for dealing with the complications caused by the nonvanishing matrix elements of chiral generators between states of different mass and spin. (auth)

26531 CONSISTENCY OF CURRENT-ALGEBRA RESULTS IN THE PRESENCE OF ELECTROMAGNETISM. Gonzalez, M. A. (Univ. of Guelph, Ont. Univ. of Washington, Seattle). Phys. rev., D; 5: No. 4, 898-900(15 Feb 1972).

It is demonstrated that despite the appearance of dynamical terms in the current-commutation relations as a result of the electromagnetic interaction, one can still use the algebra of currents to derive low-energy results. (auth)

26532 HIGH-ENERGY PARTICLES AS EXTERNAL SOURCES. Harrington, David R. (Rutgers–The State Univ., New Brunswick, N. J.). Phys. Rev., D; 5: No. 4, 892-8(15 Feb 1972).

Using methods previously used to derive the relativistic eikonal approximation it is shown that high-energy particles are approximately equivalent to external moving point sources. This result is independent of the nature of the rest of the process involved, but holds only when the high-energy particle does not suffer significant changes in its four-momentum, nor changes in its internal state, during its interactions with the other particles. (auth)

26533 NONDYNAMICAL STRUCTURE OF COLLINEAR PROCESSES. Moravcsik, Michael J. (Univ. of Oregon, Eugene). Phys. Rev., D; 5: No. 4, 836-45(15 Feb 1972).

The dynamics-independent structure of collinear reactions involving particles of arbitrary spins is investigated. The constraints on the M matrix are discussed and the consequences on the experimental observables are derived. These consequences simplify the tests of many conservation laws and make it also easier to determine experimentally the invariant amplitudes in the M matrix. A generous supply of examples is worked out in considerable detail. (auth)

26534 POLARIZATION OF SPIN-½ PARTICLES IN SCATTERING PROCESSES. Krase, L. D.; Good, R. H. Jr. (Iowa State Univ., Ames). Amer. J. Phys.; 40: No. 4, 565-70(Apr 1972).

For a beam of spin-½ particles with definite momentum, a complete description of the spin state is provided by a single three-space vector, the polarization. It is shown how the polarization-vector description provides a clear and vivid picture of spin effects in scattering processes. Explicit results are given for three types of interaction with a fixed source in first order: Coulomb, scalar, and pseudoscalar. The effect of a scattering is given by a vector-algebra formula, in which the final polarization is given in terms of the initial polarization and the momenta. In the Coulomb case, for example, the result of the scattering is that the polarization is rotated through an angle β about the normal to the scattering plane, in the same direction that the momentum is rotated. The rotation of the polarization is less than that of the momentum and the lag angle is given by $\cos(\theta - \beta) = 1 - [(m/E)\tan\frac{1}{2}\theta]^2/1 + [(m/E)\tan\frac{1}{2}\theta]^2$, where E is the electron energy and θ is the scattering angle. (auth)

26535 DIFFRACTIVE-MULTIPERIPHERAL MODEL FOR THE POMERANCHUK SINGULARITY AND ITS RELATION TO INCLUSIVE EXPERIMENTS. Yesian, Harry John San Diego, Calif.; Univ. of California (1971). 97p. University Microfilms Order No. 72-6465.

Thesis.

A bootstrap of a diffractive Pomeranchuk singularity which gives rise to constant total cross sections is carried out in the framework of a multiperipheral model for particle production in which the Pomeranchuk singularity is exchanged at most once. In this model, the multiperipheral fragmentation does not build up a diffractive component and so, in a Regge language, there is no triple Pomeron coupling. In order that one may probe the nature of the Pomeranchuk singularity through inclusive experiments, the results of this model for multiplicity distributions and inclusive experiments are analyzed and contrasted with those of presently existing multiperipheral models. In the model, the single particle spectrum satisfies the hypothesis of limiting fragmentation of Yang et al., and Feynman, but does not have pionization. As a consequence, it is found that the average multiplicity, $\bar{n}$, is asymptotically constant. By invoking the duality hypothesis for the Reggeon-particle absorptive part, it is shown how a semiquantitative understanding of diffraction dissociation into low missing masses can be achieved in the absence of a triple Pomeron coupling. A set of coupled, nonlinear integral equations for the Pomeron residue functions are derived and solutions are presented which explicitly exhibit factorization. (Diss. Abstr. Int., B)

26536 QUASIPOTENTIAL EQUATION FOR SPIN ½ PARTICLES IN CONFIGURATION REPRESENTATION AND RELATIVISTIC SPHERICAL SPINORS. Mateev, M. D.; Mir-Kasimov, R. M.; Skachkov, N. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 10: No. 1, 3-10(Jan 1972). (In Russian).

The quasipotential equation describing the interaction of particles with spins ½ and 0 is considered. The matrix elements of the principal series of the Lorentz group unitary representations are used to introduce relativistic spherical spinors and to perform a transition to the configuration representation. (auth)

26537 GENERALIZED TRANSVERSE MOMENTUM DISTRIBUTIONS. Nebb, T. L.; Savit, R.; Blankenbecler, R. (Stanford Univ., Calif.). Phys. Lett.; 38B: No. 7, 515-18(3 Apr 1972).

Simple models are used to argue that distributions in generalized transverse momentum variables can be used to study various aspects of the transverse spatial structure in production processes and distinguish between competing inelastic mechanisms. (auth)

26538 INVARIANT AND ANGULAR VARIABLES FOR FIVE PARTICLE PROCESSES. Byckling, Eero; Pirilae, Pekka (Univ. of Helsinki). Z. Phys.; 250: No. 5, 379-86(1972).

Angles and rapidity variables which are simply related to the invariants of a five-particle process are derived and the connecting equations established. Classification of the different forms of the phase space integral, obtained by successive use of these equations, is given. The symmetric treatment clarifies the meaning of several (commonly used or here introduced) sets of variables. (auth)

26539 TOWARDS AN UNDERSTANDING OF THE SHAPES OF INCLUSIVE SPECTRA. Salin, Ph.; Thomas, G. H. (Argonne National Lab., Ill.). Nucl. Phys.; B38: No. 2, 375-86(1972).

Shapes of inclusive distributions as a function of longitudinal momentum are investigated using Regge phenomenology. A dual six-point function is used as a guide to guess the general structure of the single Regge limit. It is found that the shapes are governed by (i) the kinematic relationships between the Mandelstam variables t and M_1^2 and the usual c.m. momentum variables x and $P_\perp^2$; (ii) the dynamics due to the intercept of the leading trajectory exchange in the t- (or u-) channel; and (iii) the presence of an exponential damping factor in x which exists in the dual model, and is required to describe the experimental data. (auth)

26540 NON-DYNAMICAL PROPERTIES OF PARTICLE REACTIONS. Csonka, Paul L.; Moravcsik, Michael J. (Univ. of Oregon, Eugene). Particles Nucl.; 1: No. 6, 337-58(Mar 1971).

A summary is given of the main results pertaining to those features of the structure of reactions involving particles of arbitrary spins which are independent of the forces acting among the particles. The aim is specifically to give a simple and self-contained compendium of facts and prescriptions to construct experiments to check conservation laws, to determine the intrinsic quantum numbers of the participating particles, and to determine the reaction matrix. The general relation between the invariant amplitudes of the S matrix and the experimental observables is exhibited, and from it a complete list of experimental tests of parity (P) conservation, time reversal (T) invariance, charge conjugation (C) invariance, and invariance under any product of P, C, and T, are given. The question of determining intrinsic parities and spins is also discussed. The discussion concludes with a list of aspects of this problem that have not been studied in detail so far. (auth)

Electromagnetic

Refer also to abstracts 26172, 26173, 26486, 26715, and 26752.

26541 (ORO-3992-79) ALGEBRAIC METHOD AND THE ELECTROMAGNETIC DECAY OF VECTOR MESONS. Boehm, A. (Texas Univ., Austin). Feb 1972. Contract AT(40-1)-3992. 19p. (CPT-133; CONF-720111-1). Dep. NTIS.

From Symposium on recent mathematical advances in particle physics; Boulder, Colo. (Jan 1972).

Algebraic models are used to calculate the decay rates for vector meson decays into $e^+ + e^-$ and $\pi^0(\eta) + \gamma$. (J.F.P.)

26542 (SLAC-Trans-141) DIFFERENTIAL PATH LENGTH OF THE PHOTONS PRODUCED BY AN ELECTRON OF VERY HIGH ENERGY IN A THICK TARGET. Clement, Gerard. Translated for Stanford Linear Accelerator Center, Calif., from Compt. Rend.; 257: 2971-3(13 Nov 1963). 3p. Dep. NTIS.

For production of a spectrum of particles from very high-energy electrons, an approximate expression is given, valid over a very broad energy range, for the differential path length of the photons produced by showers in a target assumed infinitely thick. (auth)

26543 COHERENT PHOTON REACTIONS AND THE DIPION CONTINUUM. Bauer, T. H. (Daresbury Nuclear Physics Lab., Eng.). Acta Phys. Pol.; B3: No. 1, 5-20(Jan-Feb 1972).

The role played by charged pion pairs in mediating high energy, forward Compton scattering, ρ^0 meson photoproduction and ρ^0 meson elastic scattering is discussed. With nucleon targets deviations from the "ρ^0-photon analogy" theory relating these interactions are found primarily in the real parts of the amplitudes. Generalizing to nuclear targets, the multiple scattering of a pion pair as well as that of the ρ^0 is taken into account. It is discussed why the quantities appearing in the conventional, Glauber multiple scattering theory of these reactions require some reinterpretation. (auth)

26544 COHERENT PROCESSES AT VERY HIGH ENERGIES. Miesowicz, M. (Academy of Mining and Metallurgy, Krakow). Acta Phys. Pol.; B3: No. 1, 105-15(Jan-Feb 1972).

The following processes were discussed: the coherent bremsstrahlung emission of photons by electrons at ~1000 GeV, the σ_{coh}-energy dependence for 3π- and 5π-production by pions in the energy interval 17 GeV to 200 GeV, interaction of pionic systems produced at very high energy with nucleons inside the nucleus. (auth)

26545 ELECTRON EXCITATION OF NUCLEON RESONANCES. Walecka, J. D. (Stanford Univ., Calif.). Acta Phys. Pol.; B3: No. 1, 117-50(Jan-Feb 1972).

The general analysis of electron excitation of nucleon resonances is presented, and the consequences of two very simple models of the nucleon are discussed. The results are compared with SLAC data on this process. (auth)

26546 ALMOST CIRCULAR ORBITS IN CLASSICAL ACTION-AT-A-DISTANCE ELECTRODYNAMICS. Andersen, C. M.; von Baeyer, Hans C. (Coll. of William and Mary, Williamsburg, Va.). Phys. Rev., D; 5: No. 4, 802-13(15 Feb 1972).

The motion of two fully relativistic classical spinless point particles interacting electromagnetically is studied in the special

case of almost circular orbits. The equations of motion are difference-differential equations with half-retarded plus half-advanced Liénard–Wiechert potentials. As expected on both physical and mathematical grounds multiple stable solutions are found and it is concluded that ordinary (Newtonian) initial conditions are not sufficient to determine the trajectories. In addition to the stable solutions an infinity of divergent solutions is found. Alternatives for dealing with the extraneous solutions are discussed. The exact equations of motion can in certain limits be approximated by differential equations. The solutions serve to delimit the range of applicability of the approximations. (auth)

26547 MAGNETIC QUARKS AND ELECTRIC QUARKS IN HADRONS. Chang, Chen-kun (Texas Coll., Tyler. Univ. of Texas, Austin). Phys. Rev., D; 5: No. 4, 950-63(15 Feb 1972).

Dirac's magnetic monopoles are generalized to have aspects which are similar to the conventional quarks (electric quarks). Such magnetic monopoles are called magnetic quarks. This work assumes that a baryon consists of three solid bodies called electromagnetic quarks, and that an electromagnetic quark and an electromagnetic antiquark form a meson. Each of these electromagnetic quarks is considered to be composed of one electric quark and one magnetic antiquark. Such a speculation solves the difficulty in statistics faced by the paraquark model and allows the existence of anomalous charge conjugation parity C of mesonic states. New baryon mass relations and magnetic moments were derived. Finally, a strong electric dipole moment is predicted to exist in a baryon state with nonzero electromagnetic-quark orbital angular momentum, $L \neq 0$. (auth)

26548 Z DEPENDENCE OF EXTERNAL BREMSSTRAHLUNG: A LABORATORY EXPERIMENT. Mudhole, T. S.; Umakantha, N. Karnatak Univ., Dharwar, India). Amer. J. Phys.; 40: No. 4, 591-5(Apr 1972).

A simple laboratory experiment to establish the Z dependence of external bremsstrahlung production in thin foils using a beta source and a NaI(Tl) scintillation detector is described. Experimentally it is observed that the external bremsstrahlung intensity is proportional to $Z^{1.97\pm0.06}$ in close agreement with the Z^2 dependence expected by theory. (auth)

26549 PHOTON MASS AND NEW EXPERIMENTAL RESULTS ON LONGITUDINAL DISPLACEMENTS OF LASER BEAMS NEAR TOTAL REFLECTION. de Broglie, Louis (Academie des Sciences, Paris); Vigier, Jean Pierre. Phys. Rev. Lett.; 28: No. 15, 1001-4(10 Apr 1972).

Recent observations by Imbert to test predictions and observations of Goos and Hänchen by reflecting a laser beam near the total reflection angle contradicts classical and quantum predictions for the longitudinal displacements of linearly polarized incident plane waves. They can be simply interpreted as a Stern–Gehrlach type of measurement of the photon spin, provided the photon has a nonzero rest mass. (auth)

26550 COMPARISON OF THE MAGNETIC DIPOLE AND ELECTRIC QUADRUPOLE SPIN PRECESSIONS. Ley-Koo, E. (Univ., Mexico City). Amer. J. Phys.; 40: No. 4, 516-25 (Apr 1972).

The spin precessions of a magnetic dipole in a uniform magnetic field and of an electric quadrupole in an axially symmetric electric field gradient are compared. The classical equations of motion, energies, and precession frequencies for both cases are derived in general pointing out the similarities and differences. By using a vector model one also obtains the quantum expressions for the energies and transition frequencies. Some results, which are relevant for the interpretation of magnetic resonance, quadrupole resonance, and perturbed angular correlation phenomena, are briefly discussed. (auth)

26551 t-CHANNEL TRANSFORMATION MATRICES FOR HELICITY AND INVARIANT AMPLITUDES FOR $\gamma + N \rightarrow 0^- + B$. Clark, Robert Beck; Manny, Ben L.; Parsons, Ronald G. (Univ. of Texas, Austin). Ann. Phys. (N. Y.); 69: No. 2, 522-54(Feb 1972).

The algebraic transformation matrices, valid for all s and t, connecting the t-channel helicity amplitudes to a corresponding set of gauge-invariant amplitudes are calculated for the photoproduction processes $\gamma + N \rightarrow 0^- + B(J^P = 1/2^+, 1/2^-, 3/2^+, 3/2^-)$. (auth)

26552 RADIATIVE CORRECTIONS IN QUANTUM ELECTRODYNAMICS WITH INTENSE FIELD AND THEIR ANALYTICAL PROPERTIES. Ritus, V. I. (Lebedev Inst. of Physics, Moscow). Ann. Phys. (N. Y.); 69: No. 2, 555-82(Feb 1972).

Diagonalization and general properties of the mass and polarization operators and Greens functions of an electron and a photon in an intense crossed field are considered exactly in the external and radiation fields. Their explicit expressions are obtained in the e^2-approximation in the radiation field, and exactly in the external field. On the mass shell they determine the elastic scattering amplitudes and other physical quantities, for example, the dependence of the anomalous magnetic moment of the electron on the field and particle momentum. Due to instability of the electron and photon in the field, the analytic properties of the mass and polarization operators differ from those in vacuum; they become entire transcendental functions of the momentum square and depend nontrivially on the dynamic variable which is proportional to the particle momentum and to the field in which these operators have an essential singularity and branching at zero. The Greens functions in the complex momentum square plane, besides the one-particle pole, have an infinite number of poles instead of the branching and cut which correspond to the spectrum of two-particle states. All the poles opened on the dynamic variable and have imaginary parts of the appropriate sign which provide correct causal properties. Different branches in the dynamic variable form retarded and advanced functions. The fourth-order radiative corrections to the elastic scattering amplitude of an electron, due to vacuum polarization, are obtained and the limits on perturbation theory are found. (auth)

26553 BOUNDS ON THE PION'S CHARGE RADIUS. Levin, D. N.; Mathur, V. S.; Okubo, S. (Univ. of Rochester, N. Y.). Phys. Rev., D; 5: No. 4, 912-15(15 Feb 1972).

The strongest possible lower and upper bounds on the electromagnetic radius of the pion are derived in terms of the modulus of the timelike form factor. Numerical evaluation indicates that the radius is bounded above by the vector-dominance value and that the form factor will not behave as a "dipole" until $t = (2E)^2 > 17$ GeV^2, if at all. The location and number of possible zeros of the form factor are discussed. (auth)

26554 MORIOND MEETING ON THE PHENOMENOLOGY OF WEAK AND ELECTROMAGNETIC INTERACTIONS. J. Phys. (Paris), Colloq.; No. 3, 128(1971). (CONF-710345).

Nineteen papers were presented during the session on electromagnetic and weak interactions, of the 6th Moriond meeting. All papers were abstracted. (France)

For abstracts of individual papers see: 25674, 26461–26463, 26489–26491, 26555–26557, 26598–26603, 26701, 26708, and 26709.

26555 ELEMENTARY INTRODUCTION TO DEEP INELASTIC ELECTROPRODUCTION AND THE PARTON MODEL. de Ruhula, A. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 3, 77-86(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

A simple review of the subject of inelastic electron–nucleon scattering at high energy and momentum transfer is given. The topics discussed are the kinematics, the experimental data, scale invariance, and the phenomenology of the process in terms of the basic ideas of the parton model of the nucleon. (France)

26556 e^+e^- INTERACTIONS AT HIGH ENERGY. EXPERIMENTAL RESULTS WITH ADONE. Silvestrini, V. (CNEN, Frascati, Italy). J. Phys. (Paris), Colloq.; No. 3, 87-91(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

The situation of the experimental groups presently working at ADONE is outlined. Preliminary experimental results are presented, referring both to tests of QED ($e^+e^- \rightarrow \gamma\gamma$; $e^+e^- \rightarrow e^+e^-$; $e^+e^- \rightarrow \mu^+\mu^-$) and to the hadronic and multiple production. In all the experiments agreement is found between experimental results and QED predictions to within approximately ±10 percent. The cross section for the production of hadrons is of the order of 10^{-32} cm^2, in a center of mass system for a 1.4 to 2.4 GeV energy range. (France)

26557 EXTENDED VECTOR DOMINANCE MODEL: ITS IMPLICATIONS ON MESON DECAYS AND e^+e^- ANNIHILATION INTO HADRONS. Bramon, A.; Greco, M. (CNEN, Frascati, Italy). J. Phys. (Paris), Colloq.; No. 3, 93-7(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

The consequences of the existence of new vector mesons are discussed. The decays $\omega, \phi \rightarrow 3\pi$; $\omega, \phi \rightarrow \pi_0\gamma$; $\pi_0, \eta, \eta' \rightarrow \gamma\gamma$; $\eta, \eta' \rightarrow \pi^+\pi^-\gamma$ are studied, taking into account the contributions of the $\rho'(M(\rho') \simeq 1.5$ GeV, $\Gamma(\rho') \simeq 0.350$ GeV) and its SU(3) part-

ners. This allows an estimate to be made of the ρ'-photon coupling and the coupling constants among the different SU(3) multiplets involved in the model. The cross sections for the production of hadrons in e^+e^- collisions are then studied, and their magnitude and behavior are predicted at total energies of the colliding beams, 2E, ranging between 1.4 and 2.4 GeV. (France)

26558 SUPER-EIKONAL MODEL OF DEEP INELASTIC ELECTRON–PROTON SCATTERING. Moreno Yntriago, Hector Manuel. Providence; Brown Univ. (1971). 98p. University Microfilms Order No. 72-8176.

Thesis.

A calculation of the νW_2 structure function of inelastic e–p scattering is presented, applying functional techniques and using a field-theoretic model of protons and neutral vector mesons. The structure function is calculated by looking at the absorptive part of an off-shell Compton amplitude that includes all possible soft, virtual, neutral vector meson exchanges. Some of these correct the electromagnetic nucleon vertex, and others provide nucleon propagator structure. The calculation exhibits the following features: In the elastic case, the absorptive part of the amplitude has the correct dependence on the square of the proton form factor. In the inelastic case, the absorptive part of the amplitude reproduces the Drell–Yan–West relation near the elastic limit. The calculation does not single out an infinite momentum frame, nor an explicit cut-off is set upon the transverse momenta of the inelastically produced particles. The calculation is renormalized, and it fulfills the low energy Compton theorem. Bjorken scaling does not hold, W_2 vanishes in the limit $\nu/m \to \infty$ for any x. There is nevertheless an approximate form of scaling at experimental values of ν/m that allows a satisfactory bracketing of the data. A survey is given of previous work. The eikonal models of high energy scattering are discussed; and the refined model used and the explicit evaluation of the expressions involved as well as the results obtained are presented. (Diss. Abstr. Int., B)

26559 ELASTIC ELECTRON SCATTERING FROM NUCLEAR MAGNETIC DIPOLE MOMENTS. Taylor, Mark Furnald. Amherst, Mass.; Univ. of Massachusetts (1971). 135p. University Microfilms Order No. 72-10,111.

Thesis.

Two studies of the elastic scattering of electrons from nuclei with magnetic dipole moments were carried out. The first consists of a calculation, in the static limit, of the cross section and asymmetry function, $S(\theta)$, for the scattering of polarized electrons from a point target to second order in the Born approximation. The contribution of the randomly oriented nuclear dipole moment is analyzed and found to be small. The second study treats the scattering of polarized electrons from nuclei with oriented magnetic dipole moments by a distorted wave method. The nucleus is described by static charge and current distributions, and the cross section is calculated to first order in the magnetic moment interaction. The various cases of orientation and polarization directions are presented and numerical results given showing the behavior of the magnetic contribution to the cross section relative to the usually dominant charge contribution at backward angles. The results indicate that magnetic effects can be significant in the backward direction and they are very sensitive to the type of model chosen for the nuclear current distribution. (Diss. Abstr. Int., B)

26560 BARYON REGGE POLE MODELS FOR SINGLE PION PHOTOPRODUCTION AND rho-PRODUCTION. Weiler, Peter R. Jr. Madison, Wis.; Univ. of Wisconsin (1971). 93p. University Microfilms Order No. 72-2040.

Thesis.

Baryon Regge pole exchange models are developed for the reactions $\gamma N \to \pi N$ and $\pi N \to \rho N$. Reggeized helicity amplitudes for fermion exchange in these reactions are derived with attention to kinematic singularities and zeros, threshold conditions, and MacDowell symmetry. The backward scattering data on $\gamma p \to \pi^0 p$ and $\gamma p \to \pi^+ n$ at high energy are fit with a model incorporating N_α, N_γ, and Δ_δ exchanges. An N_γ trajectory nearly degenerate with the N_α trajectory is needed. The structure in the experimental differential cross sections is explained as dominance of isospin $\frac{1}{2}$ exchanges at small u giving way to dominance of isospin $\frac{3}{2}$ exchanges at large u. As expected from duality of direct channel resonances and Regge pole exchanges, the model extrapolates through the mean of the intermediate energy data on the $\gamma p \to \pi^0 p$ differential cross section at 180°. Backward scattering data for the reactions $\pi^+ p \to p\rho^+$, $\pi^- p \to p\rho^-$, and $\pi^- p \to n\rho^0$ are also described with a model based on N_α, N_γ, and Δ_δ Regge pole exchange. Two tests of the vector dominance model are made comparing backward scattering differential cross sections of $\gamma N \to \pi N$ and $\pi N \to \rho N$. (Diss. Abstr. Int., B)

26561 $O_{3,1}$ SYMMETRY AND BACKWARD PHOTOPRODUCTION OF PIONS. Khan, A. R. (F. C. Coll., Lahore); Saleem, M. Nuovo Cim.; 8A: No. 3, 570-4(1 Apr 1972).

The formalism of Delbourgo, Salam and Strathdee is extended to inelastic backward scattering and it is shown that the absence of dip in the backward photoproduction of pions follows as a natural consequence of $O_{3,1}$ symmetry of scattering amplitudes. (auth)

26562 MAGNETIC MOMENT OF OCTET-BARYONS IN A SPIN $\frac{3}{2}$ QUARK MODEL. Chand, Ramesh (Univ. of Texas, Austin. Himachal Pradesh Univ., Simla, India). Particles Nucl.; 3: No. 1, 53-9(Jan 1972).

In a spin $\frac{3}{2}$ quark model, magnetic moment of octet-baryons are calculated. It is assumed that the physical baryon octet is given by: 8 (physical) = $[8' \chi \cos\theta + 8 \chi' \sin\theta]\, f(r)$, where f(r) depends on the space-time variables; 8 and 8' are unitary-spin wave functions arising from $3 \otimes \bar{3}$ and $3 \otimes 6$ respectively; χ and χ' are spin wave functions in the $s = \frac{1}{2}$, $m = \frac{1}{2}$ state, arising from $3/2 \otimes 2$ and $3/2 \otimes 1$ respectively; θ is the SU(3) mixing parameter. For $\theta = 2.5°$, it is found that $\mu_p/\mu_n = -1.460$, and $\mu_\Lambda = -0.72$, which are in good agreement with the experimental data. (auth)

26563 GROUP-THEORETICAL ANALYSIS OF ELEMENTARY PARTICLES IN AN EXTERNAL ELECTROMAGNETIC FIELD. III. THE RELATIVISTIC PARTICLE IN A CIRCULARLY POLARIZED PLANE WAVE AND ITS MASS SHIFT. Richard, J. L. (CNRS, Marseille. Univ. of Texas, Austin). Nuovo Cim.; 8A: No. 3, 485-500(1 Apr 1972).

The symmetry properties of a particle interacting with an electromagnetic circularly polarized plane wave are considered. The classical and quantum analysis of the stability group of the plane wave exhibits the origin of the mass shift of the particle. The Chakrabarti's dynamical representation of the Poincaré group is rederived and its physical meaning is given. (auth)

26564 EXACT MOTION OF A CHARGED PARTICLE IN A SPECIAL MAGNETIC FIELD. Hautot, A. P. (Univ., Liege). Physica; 58: No. 1, 37-44(1 Mar 1972).

The relativistic equations of motion are completely solved for a special configuration of the external magnetic field $B = (x^2 + y^2)^{-\frac{1}{2}} [(-\gamma y)/(x^2 + y^2), (\gamma x)/(x^2 + y^2), \alpha]$, a case which seems to have never been considered before. It is also shown how the quaternionic formalism can replace the traditional Lagrange formalism in that kind of problem. The characteristics of the movement are briefly discussed in all possible cases. (auth)

26565 QUANTIZED CHARGE IN TERMS OF PURE GEOMETRY. Westenholz, C. V. (Univ., Muenster, Ger.). Ann. Inst. Henri Poincare, Sect. A; 15: No. 3, 189-202(Oct-Nov 1971).

It has been shown that unquantized charge may be regarded as a manifestation of a suitably chosen geometry. It is proved that, under appropriate restrictions, quantized charge may be considered as a manifestation of some curved space–time geometry as well. (auth)

26566 CANONICAL DYNAMICS OF RELATIVISTIC CHARGED PARTICLES. Sniatycki, J.; Tulczyjew, W. M. (Calgary Univ., Alberta). Ann. Inst. Henri Poincare, Sect. A; 15: No. 3, 177-87 (Oct-Nov 1971).

A formulation of relativistic dynamics of charged particles in terms of the geometry of symplectic manifolds is studied. The concept of canonical system (a symplectic manifold together with a submanifold) is introduced, and Hamiltonian dynamics is formulated in terms of canonical systems. Then canonical systems are applied to relativistic dynamics of charged particles. A different version of this dynamics based on Kaluza theory is discussed. (France)

26567 PHOTON PRODUCTION BY AN EXTERNAL FIELD. Sokolov, A. A.; Skobelev, V. V.; Gal'tsov, D. V.; Loskutov, Yu. M. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 62: No. 2, 454-7 (Feb 1972). (In Russian).

Photon production by a varying electromagnetic field is considered in the low-energy approximation. (auth)

26568 THEORY OF MAGNETOBREMSSTRAHLUNG RADIATION IN MATTER. Andreev, S. P. (Moscow Engineering-Physics Inst.). Zh. Eksp. Teor. Fiz.; 62: No. 2, 514-24(Feb 1972). (In Russian).

The radiation emitted by an ultrarelativistic particle moving in matter along or across a magnetic field is investigated. The spectral distribution of the radiation intensity is determined for frequencies which can be treated classically. It is shown that in the case of motion along a strong magnetic field the spectral

distribution of the radiation intensity nonlinearly depends on the time of motion of the particle in the matter. For particles moving perpendicular to a weak magnetic field the spectrum has a plateau which depends on the properties of the medium. (auth)

26569 REFLECTION OF A PHOTON WITH A SMALL MASS: FORMULAS FOR THE PASSAGE OF THE FIELDS ACROSS THE REFLECTING PLANE. Costa de Beauregard, Olivier (Univ., Paris). Compt. Rend., Ser. B; 274: No. 2, 101-3(10 Jan 1972). (In French).

The reflection of a photon having a very small rest mass by an isotropic interface of permittivity ϵ and permeability μ at rest in a Lorentzian system was studied. A calculation which does not involve any approximation demonstrates that the glass-type reflection of an electric or magnetic transverse wave (in the interface system) is possible and does not involve longitudinal photons. (France)

26570 MULTIHADRONIC CROSS SECTIONS FROM e^+e^- ANNIHILATION AT C. M. ENERGIES BETWEEN 1.4 and 2.4 GeV. Bacci, C. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome); Penso, G.; Salvini, G.; (and others). Phys. Lett.; 38B: No. 7, 551-4(3 Apr 1972).

Multihadronic production has been observed at the Adone e^+e^- storage ring, in the c.m. energy range 1.4 to 2.4 GeV. The cross sections for the reactions $e^+ + e^- \to 2\pi^\pm + n\pi^0$ $(1 \le n \le 4)$ and $e^+ + e^- \to (4\pi^\pm + n\pi^0;\ 6\pi^\pm)$ $(0 \le n \le 2)$ were measured, assuming that the produced particles are only pions with a pure phase space momentum distribution. (auth)

26571 HELICITY STRUCTURE OF NUCLEON RESONANCE ELECTROPRODUCTION AND THE SYMMETRIC QUARK MODEL. Close, F. E.; Gilman, F. J. (Stanford Univ., Calif.). Phys. Lett.; 38B: No. 7, 541-3(3 Apr 1972).

The symmetric quark model with harmonic forces is shown to lead to a rapid change with q^2 of the helicity structure for electroproduction of the second (D_{13}) and third (F_{15}) nucleon resonances. Preliminary results of coincidence measurements of pi-zero electroproduction in the resonance region are found to disagree with this prediction. Some further experimental tests and theoretical consequences of this failure are discussed. (auth)

26572 DETERMINATION OF THE RADII OF ELEMENTARY PARTICLES (pi,p) BASED ON THE ANALYTICAL PROPERTIES OF THEIR FORM FACTORS. Baluni, V. (Moscow State Univ.). Phys. Lett.; 38B: No. 7, 535-7(3 Apr 1972).

The upper and lower bounds on the msr of the elementary particle are established. Making use of the experimental distribution of the magnitude of the form factor modulus in the annihilation channel, $r_\pi = 0.7 \pm 0.15$ fm is obtained. 0.63 ± 0.19 fm $\le r_{EP} \le 0.69 \pm 0.18$ fm is also obtained by making use of the experimental values of the proton electric form factor at two space-like points. (auth)

26573 DEEP INELASTIC ELECTRON–PROTON AND ELECTRON–NEUTRON SCATTERING. Hacinliyan, A. (Univ. of Chicago). Nuovo Cim.; 8A: No. 3, 541-69(1 Apr 1972).

Formulae for the structure functions W_1 and W_2 are obtained by means of the statistical approach to the Veneziano model together with pomeron dominance. A form for W_2 is obtained that scales and agrees well with the data. The question of the scaling of W_1 is discussed. Phase-space corrections and generalized Glauber corrections are then studied in connection with e-D scattering; they are found to be small. Hence, contributions from both the pomeron and lower trajectories are used to generalize the model. Satisfactory agreement is obtained. (auth)

26574 ACCELERATION OF CHARGED PARTICLES AND RADIATION-REACTION IN STRONG PLANE AND SPHERICAL WAVES. Heintzmann, H. (Univ., Cologne); Grewing, M. Z. Phys.; 251: No. 1, 77-86(1972).

A comparison between the acceleration of charged particles in plane and spherical waves including the effect of radiation reaction is given. In strong electromagnetic waves the charged particle stays initially at practically constant phase—"phase locked" part of the motion—and only after it has travelled many wavelengths does the wave overtake the particle. During the phase-locked part of the motion depending upon the initial conditions of how a particle is injected into the wave radiation reaction can lead to both a net energy gain or loss compared to the motion without radiation reaction. In a plane wave however radiation reaction always leads to a net energy gain if it can build up long enough. A test of this latter prediction by means of ultrastrong lasers might be possible. (auth)

26575 SYNCHROTRON RADIATION FROM AN ELECTRON IN UNIFORM HELICAL MOTION. Lee, Y. H.; Kim, J. S. (State Univ. of New York, Albany). J. Korean Phys. Soc.; 4: No. 2, 43-6(Sep 1971).

The power radiated by an intermediate-energy electron in uniform helical motion was derived. The derivations are considerably simpler than those made with the aid of the Lienard–Wiechert potential. (auth)

26576 COMPARISON OF THE DIFFRACTION-DISSOCIATION MODEL FOR HIGH-ENERGY RHO PHOTOPRODUCTION WITH EMPIRICAL DATA. Kramer, G. (Univ., Hamburg). Z. Phys.; 250: No. 5, 413-35(1972).

Diffraction-dissociation models are compared for two-pion photoproduction in the p-wave state with recent data of the SLAC-Berkeley-Tufts collaboration. Two models for two-pion final-state interaction are considered. One is the model worked out earlier which leads to a monotonic modification of the $\pi^+\pi^-$ p-wave spectrum with momentum transfer and has for $t = 0$ the extra factor $(m_\rho/m)^4$ compared to the usual Breit-Wigner factor. The other model has a zero in the spectrum around $m = 1.1$ GeV which is shifted with momentum transfer. (auth)

26577 CONNECTION OF THE DEUTERON FORM FACTORS WITH THE PHYSICAL S-MATRIX. III. Troitskii, V. E.; Trubnikov, S. V.; Shirokov, Yu. M. (Moscow State Univ.). Teor. Mat. Fiz.; 10: No. 3, 349-59(Mar 1972). (In Russian).

The relativistic Jost matrix for the neutron-proton scattering is evaluated via the n–p physical phases. The positive parity states with angular momentum equal to one were considered. The pole corresponding to the deuteron state with the d-wave is embedded onto the physical sheet of the Rieman surface of the Jost matrix. Analytical continuation of the electromagnetic form factors of the n–p system up to the deuteron pole is performed. The obtained intermediate results were used for the calculation of the electromagnetic deuteron form factors via those of the single particles and the integrals over the physical n–p scattering phases. (auth)

26578 VECTOR MESON DOMINANCE PREDICTIONS FOR SINGLE PION ELECTROPRODUCTION. Kellett, B. H. (Univ. of Manchester, Eng.). Nucl. Phys.; B38: No. 2, 573-86(1972).

Predictions for π^+ electroproduction are obtained by using vector meson dominance to continue the pion photoproduction amplitudes to spacelike values of the virtual photon mass. The continuation is performed by formulating vector dominance in terms of invariant rather than helicity amplitudes, and the longitudinal polarization states of the virtual photon are given in terms of the photoproduction invariant amplitudes. Previous vector dominance predictions for electroproduction from vector meson production have encountered difficulty with the sign of the longitudinal-transverse interference term in the cross section. In the present model, however, the structure of this term is explained naturally in terms of the kinematical k^2 dependence of the longitudinal amplitudes, and excellent agreement with all the data is obtained. These results complete the unified description of vector meson production, pion photoproduction, and pion electroproduction in terms of a covariant vector meson dominance model. (auth)

26579 POLARIZATION EFFECTS IN DEEP ELECTROPRODUCTION AND THE QUARK PARTON MODEL. Gourdin, M. (CERN, Geneva). Nucl. Phys.; B38: No. 2, 418-28(1972).

Deep inelastic scattering of longitudinally polarized leptons from polarized nucleons is studied phenomenologically and the parallel antiparallel asymmetry is computed using the quark parton model. (auth)

26580 ASYMMETRY IN INELASTIC ELECTRON–POLARIZED PROTON SCATTERING. Leroy, J. P.; Piketty, C. A. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nucl. Phys.; B38: No. 2, 466-76(1972).

The electron asymmetry induced by final electromagnetic interaction in inelastic scattering on a polarized target near the $\Delta(1236$ MeV) resonance was estimated. The nucleon and the Δ-intermediate states only are considered. Unexpectedly, the nucleon contribution remains dominant for almost all energies. For incident energies larger than 5 GeV a maximum effect around 1% is found. (auth)

26581 DIFFRACTIVE PHOTOPRODUCTION OF THE ρ-MESON. Derado, I.; Kronseder, G.; Schacht, P.; Schlamp, P. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nucl. Phys.; B38: No. 2, 541-54(1972).

ρ^0 photoproduction is analyzed in the framework of the Regge pole model, considering only pomeron exchange and assuming conservation of the photon helicity in the s-channel for small

momentum transfer ($|t| < 0.3$ (GeV/c)^2). The main features of ρ^0 photoproduction are well described. (auth)

26582 CYCLOTRONIC RESONANCE IN THE VACUUM POLARIZATION. Shabad, A. E. (Lebedev Inst. of Physics, Moscow). Lett. Nuovo Cim.; 3: No. 11, 457-60(11 Mar 1972).

The photon mass spectrum in an external magnetic field is studied. Special attention is given to some qualitative effects due to the resonant situation occurring in the problem. The channeling of photons incident to a pulsar by its magnetic field is mentioned. (J.F.P.)

26583 NUCLEON FORM FACTORS, VECTOR DOMINANCE, AND LORENTZ CONTRACTION. Licht, Arthur Lewis; Pagnamenta, Antonio (Max-Planck-Institut fuer Physik und Astrophysik Munich). Particles Nucl.; 2: No. 1, 21-8(Jul 1971).

Vector meson dominance with only the observed vector mesons ρ, ω, ϕ, and the effect of Lorentz contraction on a cluster of n particles is used to derive an expression for the nucleon electromagnetic form factors. With three quarks the observed t^{-2} dependence and a one parameter fit to the data are found. A small but nonzero electric form factor for the neutron as well as small deviations from the scaling laws are predicted. (auth)

26584 GYROMAGNETIC RATIO OF THE PROTON: A SURVEY. Vigoureux, P. (National Physical Lab., Teddington, Eng.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 111-15(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The gyromagnetic ratio of the proton can be determined in terms of the ampere by two methods: one uses a weak magnetic field, the other a strong magnetic field. Either method used singly yields the constant if a current balance or other dynamometer is also available, but if equipment for both methods is provided, the dynamometer can be dispensed with, and not only the gyromagnetic ratio, but also the ampere, obtained. There may be advantages therefore in building equipment for both methods, especially in laboratories which do not possess a current balance. As however one of the operations in the strong-field method consists in "weighing" a current, the final result is liable to approximately the same uncertainty which affects the weak-field method combined with a current balance. (auth)

26585 γ'_p DETERMINATION AT THE ETL: TWO PROPOSALS FOR OBTAINING A UNIFORM CALCULABLE MAGNETIC FIELD FOR AN ATOMIC STANDARD OF CURRENT. Hara, Ko; Nakamura, Hisao (Electrotechnical Lab., Tokyo). Nat. Bur. Stand. (U.S.), Spec. Publ.; No. 343, 123-30(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Two methods for obtaining improved calculable magnetic fields for low field γ'_p determinations are discussed. In the first, a single layer solenoid of proper proportion is modified to a solenoid of fourth order uniformity, without any correction coil for uniformity. In the second, a solenoid is confined in a box of high μ material. This gives a calculable uniform field because of imaging effects. A practical arrangement is given for use when μ is not extremely high. In this method, isolation from external fields is achieved. (auth)

26586 DUALITY AND INELASTIC ELECTRON–NUCLEON SCATTERING. Gilman, Frederick J. (Stanford Univ., Calif.). pp 116-47 of Proceedings of the International Conference on Duality and Symmetry in Hadron Physics. /Gotsman, E. (ed.). Jerusalem; Weizmann Science Press of Israel (1971).

From Conference on duality and symmetry in hadron physics; Tel Aviv, Israel (5 Apr 1971).

The present state of the available experimental information on inelastic electron–nucleon scattering is first reviewed. Particular attention is then given to the ways in which the behavior of elastic scattering and nucleon resonance electroproduction are related to the behavior of deep inelastic scattering. The application of duality to inelastic electron–nucleon scattering is discussed. Some additional aspects of some theoretical models proposed to explain deep inelastic scattering, as well as some open questions of the nature of the hadronic final state, are finally discussed. (L.B.S.)

26587 LIGHT CONE CURRENT ALGEBRA. Fritzsch, Harald (Max-Planck-Institut fuer Physik und Astrophysik, Munich); Gell-Mann, Murray. Contract AT(11-1)-68. pp 317-74 of Proceedings of the International Conference on Duality and Symmetry in Hadron Physics. /Gotsman, E. (ed.). Jerusalem; Weizmann Science Press of Israel (1971).

From Conference on duality and symmetry in hadron physics; Tel Aviv, Israel (5 Apr 1971).

An attempt is made to show that a number of different ideas of the last few years on broken scale invariance, scaling in deep inelastic electron–nucleon scattering, operator product expansions on the light cone, parton models, and generalizations of current algebra, as well as some new ideas, form a coherent picture. (L.B.S.)

26588 NOTE ON A CONSEQUENCE FROM ANALYTICITY OF FORM FACTOR. Kawai, T.; Kiang, D.; Morita, K. (Dalhousie Univ., Halifax, N. S.). Lett. Nuovo Cim.; 3: No. 14, 609-10(1 Apr 1972).

It is shown that the bound on the form factor F(t) obtained by Nguyen as a consequence of analyticity can be improved by introducing the additional assumption that $|F(t)|$ does not vanish except possibly on the cut and at infinity. (L.B.S.)

26589 POLARIZATION AND ANGULAR DISTRIBUTION OF RADIATION OF ELECTRONS MOVING IN A FOCUSING MAGNETIC FIELD. Zhukovskii, V. Ch.; Shichanin, O. E. (Moscow State Univ.). Izv. vyssh. Ucheb. Zaved., Fiz.; No. 3, 52-8(1971). (In Russian).

The angular distribution was obtained for components of linear polarization of radiation of an electron which is moving in an inhomogeneous weakly-focused magnetic field. The form of the distribution was investigated as a function of amplitude values of actual and radial betatron oscillations. A minimum intensity of the π-component of radiation does not revert to zero in contrast to a homogeneous field. (tr-auth)

26590 NONEXISTENCE OF ISOLATED CHARGED MONOPOLES IN UNIFIED FIELD THEORIES. Tiwari, R.; Pant, D. N. (Banaras Hindu Univ., India). J. Phys., A (London); 5: No. 3, 394-400(Mar 1972).

The possibility of the existence of isolated electric charge giving rise to a spherically symmetric electrostatic field was considered in each of the unified field theories of Einstein, Schrödinger and Bonnor. It was proved that none of these theories admits such a possibility. (auth)

Weak

Refer also to abstracts 26461, 26463, and 26720.

26591 (ORO–3992-65) SOME ASTROPHYSICAL IMPLICATIONS OF SECOND-ORDER EFFECTS IN THE V-A THEORY OF WEAK INTERACTIONS. Lopez-Cepero, A. B.; Maiella, G. (Texas Univ., Austin. Center for Particle Theory). Mar 1972. Contract AT(40-1)-3992. 31p. (CPT–115). Dep. NTIS.

The process $e^+ + e^- \rightarrow \nu + \bar{\nu}$ and the extent to which second-order terms contribute to the first-order effects are investigated. A treatment is given for the second-order terms in the light of the possible nonexistence of the first-order process. Other processes contributing to neutrino emission rates and possible modification due to the second-order term are mentioned. The most important conclusion on astronomical evidence is the inadequacy of second-order and higher effects to account for observations should the diagonal coupling process be strictly forbidden. It is noted that an area in which second-order and higher terms have an effect is at temperatures greatly in excess of 10^{10}°K which are found in the presupernova collapse of a stellar core and the initial expansion phase of the primal universe. (J.F.P.)

26592 (PITHA–59) FOCUSING OF NEUTRINO PARENTS BY ELLIPTICAL LENSES. Faissner, H.; Hasert, F. J.; von Krogh, J.; Thome, W. (Technische Hochschule, Aachen (West Germany). Physikalisches Institut (III)). 1972. 32p. Dep. NTIS (U. S. Sales Only).

Current sheets with the shape of a rotational ellipsoid behave as lenses for particles passing at small angles to the symmetry axis. Their focal length is proportional to the particle momentum p. This is a big advantage by comparison with a symmetric quadrupole doublet, whose focal length goes with p^2. Elliptical lenses can be combined into lens systems, using the standard methods of geometrical optics. Neutrino spectra for 300 GeV primary energy were computed for a two-lens system. By varying distances and currents one can produce either a wide-band beam comparable to that of a magnetic horn, or a medium-band beam of variable energy, or a flat high-pass beam. (auth)

26593 NEUTRINO PRODUCTION OF LEPTON PAIRS. II. Koike, Kazuo; Konuma, Michiji; Kurata, Koji; Sugano, Kimio (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1799-1804(Dec 1971).

The charged-lepton angular correlation for the neutrino pro-

duction of lepton pairs is calculated numerically in the coplanar case. It is shown that the incoherent process is negligible in the forward emission of charged lepton pair. The result can be directly verified experimentally. (auth)

26594 $\Delta I = 1/2$ RULE, LEE–SUGAWARA RELATION AND CABIBBO'S WEAK HAMILTONIAN. Naito, Seichi (Osaka City Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1805-36(Dec 1971).

Nonleptonic decays of hyperons are treated explicitly using the fact that there appear only charged currents in Cabibbo's weak Hamiltonian H_W. For simplicity, a system consisting only of octet baryons, decuplet baryons, octet pseudoscalar mesons, octet axial vector mesons and octet vector mesons is considered. However, all possible three-point strong interactions are taken into account. Under several assumptions about strong interactions, decay amplitudes are analyzed in the order g^3G (where g (G) is the strong (weak) coupling constant), because the amplitudes in the order gG are found to be negligible. First, S-wave amplitudes are calculated in the following two limits, i.e., the SU(3) limit and the soft pion limit. In these limits, it is shown that special Feynman graphs exhaust all the contributions to S-wave amplitudes. Then, using time reversal invariance of H_W, we obtain amplitudes which are the same (at some points) as those found by Suzuki and Sugawara. If only one additional condition is assumed, the results become consistent with experiment. Although the amplitudes are similar to those in the K*-exchange model, it should be noticed that the latter vanish in the soft pion limit. Secondly, P-wave amplitudes are calculated in the SU(3) limit, with the help of all possible Feynman graphs for hyperon decays, and the conditions under which the P-wave amplitudes thus obtained can be consistent with experiment are investigated. Then, it is found that the experimental P-wave amplitudes can be obtained only when the cooperative mechanism among various Feynman amplitudes is understood. (auth)

26595 APPARENT VIOLATION OF THE $\Delta S = \Delta Q$ RULE IN HIGH-ENERGY NEUTRINO PROCESSES. Hayaski, Takemi (Hiroshima Univ.); Kobayashi, Makoto; Nakagawa, Masami; Nitto, Hidemitsu Progr. Theor. Phys. (Kyoto); 46: No. 6, 1944-5(Dec 1971).

The production of the super hadron corresponding to the fourth hypothetical ur-baryon by high-energy neutrinos according to a two-step process is examined in the quartet model. It is indicated that through the two-steps of the semi-leptonic and nonleptonic interactions, an apparent violation of the $\Delta S = \Delta Q$ rule and of the isospin selection rule will definitely arise. (L.B.S.)

26596 CPT INVARIANCE AND WEAK INTERACTIONS. Hsu, J. P. (McGill Univ., Montreal). Phys. Rev., D; 5: No. 4, 981-7 (15 Feb 1972).

The pure leptonic and semileptonic weak interactions, together with the possible violation of CPT invariance, are studied by explicitly constructing a model of weak interactions. At low energies, the Fermi effective Lagrangian is considered. The divergences in the model are no worse than those in the well-known renormalizable theories. The model suggests that if CPT invariance is violated in the weak interactions, so is Lorentz invariance. Furthermore, CPT violation cannot be detected by measuring the difference of lifetime, mass, or magnetic moment between the usually observed particle and antiparticle. It should be tested by measuring the deviation of the particle lifetime at high energies. Experimentally, the lifetimes of the charged kaon and the muon appear to be shorter at higher energies, as predicted by the model. The model is in agreement with the known experiments and gives many specific predictions. (auth)

26597 NEUTRINOS WITH MASS AND THE DECAY $K_L^0 \rightarrow \bar{\nu}_l + \nu_l$. Barshay, Saul (Univ. of Copenhagen). Phys. Rev. Lett.; 28: No. 15, 1008-9(10 Apr 1972).

One of the few exact results that would be vitiated by the recently discussed possibility of neutrinos with mass, would be the statement of the forbidden nature of the decay $K_L^0 \rightarrow \bar{\nu}_l + \nu_l$ because of angular-momentum conservation in the usual neutrino theory. It is noted that the decay $K_L^0 \rightarrow \bar{\nu}_\mu + \nu_\mu$ could easily exist with a rate comparable to that for $K_L^0 \rightarrow 2\gamma$ if $m_{\nu_\mu} \approx 100$ eV. The processes $\nu_l + p \rightarrow \nu_l + \Sigma^+$, $\nu_l + n \rightarrow \nu_l + \Lambda$ and $\Sigma^+ \rightarrow p + \bar{\nu}_l + \nu_l$, $\Lambda \rightarrow n + \bar{\nu}_l + \nu_l$ would then occur in lowest order, but at minute rates. (auth)

26598 CABIBBO THEORY. Jarlskog, C. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 3, 17-25(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

After giving a short summary of those hypotheses which are essential in understanding the Cabibbo theory, a simple review of the subject with emphasis on the semileptonic baryon decay is presented. The theoretical aspects of the most recent fits to the Cabibbo theory are also discussed. (France)

26599 LEPTONIC K DECAYS. Gaillard, M. K. (Paris Univ., Orsay, France). J. Phys. (Paris, Colloq.; No. 3, 33-44 (1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

Theoretical ideas used in the description of form factors associated with leptonic K decay are reviewed with particular emphasis on current algebra and soft pion theorems. Predictions are compared with experimental results and the strong interaction symmetry implications are discussed. (France)

26600 $\Delta S = \Delta Q$ RULE. James, F. (European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 3, 71-6(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

The current theoretical and experimental situation concerning the validity of the $\Delta S = \Delta Q$ selection rule in strangeness-changing weak interactions is reviewed. It is seen that previous evidence for a small violation of the rule is not confirmed by more recent experiments, which set an upper limit of a few percent for the ratio of violating to nonviolating amplitudes. (France)

26601 NEW RESULTS IN THE QUARK PARTON MODEL. Nachtmann, O. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 3, 99-103(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

The quark parton model for deep inelastic lepton-hadron scattering is analyzed using the powerful tools of SU(3) invariance and positivity. It is found that the model predicts the structure functions for electro- and neutrino production to lie within certain positivity domains, which are given explicitly. A comparison is made with available data; predictions for neutrino experiments are presented. (France)

26602 NEUTRINO IDENTITY. Glashow, S. L. (Harvard Univ., Cambridge, Mass.). J. Phys. (Paris), Colloq.; No. 3, 109-11(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

The conventional model of weak interactions incorporates a simple, yet far reaching, hypothesis concerning neutrino identity: the independent conservation of muon number and electron number. It is argued that this hypothesis can and should be tested experimentally. (France)

26603 QUARKS, LEPTONS, AND WEAK INTERACTIONS. Achiman, Y. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 3, 113-16(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

Using a fourth neutral quark, weakly interacting particles are classified, without changing the strong interaction content of the quark model. Leptons are in the octet which includes heavy leptons. Weak interactions are represented graphically by quark diagrams in an analogous way to strong ones. They are practically of a current–current nature. The octet of bare weak hadronic currents has exactly the same quark structure as in the lepton case (generalized universality). The usual selection rules for weak interactions follow without any additional assumptions. The representation deals with internal quantum numbers only and may be used as a natural framework for different theories of weak interactions, using various assumptions about the external dynamical nature of the theory. (France)

26604 SELECTED TOPICS IN SEMILEPTONIC AND LEPTONIC WEAK INTERACTIONS. Tarter, James Madison. Pittsburgh; Univ. of Pittsburgh (1971). 96p. University Microfilms Order No. 72-7585.

Thesis.

The lowest-order perturbation theoretic consequences of a weak leptonic current which includes vector and axial vector derivative terms in addition to the usual V–A terms. Two component neutrinos and time reversal invariance were not assumed.

It was found that, in spite of the increase of the number of empirically determined parameters, the lowest order V–A perturbation theoretic predictions are not significantly improved (as measured by present experimental results). The perturbation theoretic predictions of the V–A current–current Lagrangian to order G^3 in allowed semileptonic and leptonic processes are evaluated. It is concluded that they are not making an appreciable contribution to the experimental observables in these processes. (Diss. Abstr. Int., B)

26605 THEORETICAL MODELS OF NONLEPTONIC DECAYS. Goswami, Dipendra Nath. Syracuse, N. Y.; Syracuse Univ. (1971). 97p. University Microfilms Order No. 72-6583. Thesis.

Two different approaches are used to the problem of nonleptonic decays. First, the Ω^- nonleptonic decays are investigated in the framework of a phenomenological chiral Lagrangian model. In this way, ambiguities of extension of meson momenta to zero which are present in the current algebra approach are made explicit. It is found that these decays may possess a rather complicated structure and a discussion of approximation schemes is given which may help to explain the present experimental data. The approximation of the $\Xi 2\pi$ decay mode by $\Xi^*\pi$ is discussed. Secondly, a pole model was constructed for nonleptonic hyperon decays where exchanged particles of all spins are included. Summation over the different spins is carried out by means of the Van Hove model, assuming that the Regge-pole term is important. It is found that a number of trajectories do not contribute for a very simple, essentially kinematical reason. A discussion of some consequences of this approach is given. (Diss. Abstr. Int., B)

26606 SECOND CLASS CURRENTS AND BROKEN SU(3)-SYMMETRY. Oehme, R. (Univ. of Chicago). Phys. Lett.; 38B: No. 7, 532-4(3 Apr 1972).

In the SU(3) limit, a second class, T-normal axial vector current, which transforms like an octet, can give rise to pseudotensor terms in the matrix elements for leptonic decays of baryons. With first order symmetry breaking, this second class current may generate pseudovector and pseudoscalar form factor contributions. It is an anti-hermitian current, but, even with SU(3) breaking, it does not need to disturb the chiral SU(2) × SU(2) algebra of charges. (auth)

26607 SELF-MASS OF LEPTONS. Mainland, G. B. (Inst. of Theoretical Physics, Goteborg). Nuovo Cim.; 8A: No. 3, 536-40(1 Apr 1972).

The self-mass of a lepton resulting from gravitational interactions, electromagnetic interactions and weak interactions mediated by an intermediate vector boson is considered. If the quadratic weak and gravitational self-mass divergences, and the logarithmic weak, electromagnetic and gravitational self-mass divergences are, respectively, assumed to cancel, the weak-coupling constant g and the mass of the intermediate vector boson M_B can be predicted. (auth)

26608 NON-LEPTONIC HADRON DECAYS AND FIELD ALGEBRA. I. PARITY VIOLATING AMPLITUDES. Gottlieb, H. P. W.; MacFarlane, A. J.; Subba Rao, J. (Cambridge Univ., Eng.). Nucl. Phys;, B38: No. 2, 529-40(1972).

The application to parity-violating non-leptonic decays of a model of weak interactions, based on the algebra of fields definition of the hadron currents that participate in weak interactions, is described. Symmetry breaking effects are included, octet dominance is built in explicitly and a careful treatment is given of the diagonalization procedure needed to identify the physical 0^- and 1^+ fields. Agreement with experiment comparable to that of K* pole and current algebra models is achieved. (auth)

26609 WEAK INTERACTIONS AND THE VECTOR DOMINANCE MODEL. Lopes, J. Leite (CRN, Strasbourg). Nucl. Phys.; B38: No. 2, 555-64(1972).

It is suggested that, in the same way that the electromagnetic form factors of hadrons are dominanted by the neutral hadronic vector mesons in interaction with the photon, the weak-reaction form factors of hadrons are correspondingly dominated by the hadronic charged vector and axial-vector mesons coupled to the intermediate W-bosons. A relationship is obtained between the coupling constants involved and Cabibbo's angle. A cancellation of dominant axial-vector pole terms in the matrix element of the nucleon axial current between neutron and proton states gives the Goldberger–Treiman relation. (auth)

26610 INEQUALITIES FOR STRUCTURE FUNCTIONS OF DEEP INELASTIC LEPTON–NUCLEON SCATTERING GIVING TESTS OF BASIC ALGEBRAIC STRUCTURES. Nachtmann, O. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nucl. Phys.; B38: No. 2, 397-417(1972).

Inequalities for the structure functions of deep inelastic electro- and-neutrino-production on nucleons are derived (a) from the quark parton model or equivalently from a hypothesis of Fritzsch and Gell-Mann on the leading light cone singularity of current commutators. (b) From the quark model with neutral gluons using current algebra techniques to the same extent as for the Callan–Gross relation. Present data satisfy these inequalities, and give stringent predictions for future neutrino-production experiments. On the other hand, three models with integrally charged partons, the SUB-model, the Drell–Levy–Yan model and the Bjorken–Glashow model are found to be in trouble by comparison with experiment. (auth)

26611 FITS TO τ^+ DALITZ PLOT WITH POWER-SERIES EXPANSIONS AND $\pi-\pi$ INTERACTION MODELS. Mainkar, V.; Kanofsky, A. (Lehigh Univ., Bethlehem, Pa.). Particles Nucl.; 1: No. 8, 459-72(May 1971).

Fits of power series expansions and $\pi-\pi$ interaction models are made to recent τ^+ data. The results indicate only the presence of a linear Y term in the power series expansion. The value of the linear term is unchanged with the addition of higher-order terms. The $\pi-\pi$ interaction model fits are consistent with the existence of a broad T = 0, J = 0 $\pi-\pi$ resonance of mass 400 MeV and full width 125 MeV. (auth)

26612 NONLEPTONIC HYPERON DECAYS IN A QUARK MODEL. Chand, Ramesh (Inst. of Mathematical Sciences, Madras); Gleeson, A. M. Particles Nucl.; 1: No. 8, 485-97 (May 1971).

In an SU(3) quark model, the parity-violating (s-wave) and the parity-conserving (p-wave) nonleptonic hyperon decays are investigated. It is assumed that the weak interaction transforms like an SU(3) octet and that the physical baryon octet is given by: 8 (physical) $= 8^\theta \cos\theta + 8 \sin\theta$, where 8 and 8^θ arise from $3 \otimes \bar{3}$ and $3 \otimes 6$ respectively. (auth)

Strong (General)

Refer also to abstract 26783.

26613 (DNPL/R-18) PARTICLE PRODUCTION IN HADRON PHYSICS. Daresbury Lecture Note Series No. 7. Humble, S. (Daresbury Nuclear Physics Lab. (England)). 1971. 76p. Dep. NTIS (U. S. Sales Only).

Notes on lectures given at Daresbury Nuclear Physics Laboratory, 5 to 9 July 1971 are discussed under the following headings: general considerations for three body reactions (invariants and kinematics; physical region; phase-space); low energy analysis (partial wave decomposition; isospin; isobar model); production processes at high energies (longitudinal phase-space plot; multi-Regge model; Regge cluster models); inclusive reactions (particle distributions; amplitude discontinuities; duality; outlook for study in hadron physics). (50 references) (UK)

26614 COMMENTS ON STATISTICAL BOOTSTRAP MODELS OF HADRONS. Alexanian, Moorad (Instituto Politecnico Nacional, Mexico City). Phys. Rev., D; 5: No. 4, 922-7(15 Feb 1972).

The statistical bootstrap models of Hagedorn and Frautschi, modified so that the volume of a hadron is allowed to vary with the temperature, are considered. It is shown that a large class of polynomial solutions for the level density of hadrons is possible. A feature common to polynomial spectra is that the volume of a hadron must vanish as the temperature approaches infinity. The requirement that hadrons have a finite size implies both a maximum temperature and an exponential hadron mass spectrum. Also, the recent formulation in terms of quasiparticles demands an exponential hadron mass spectrum without requiring an asymptotic bootstrap condition. A unique solution, $\rho(m) \sim m^{-\frac{5}{2}} e^{m\beta}$ as $m \to \infty$, is obtained if one assumes the asymptotic bootstrap condition of Hagedorn. (auth)

26615 HIGH ENERGY ELON–NUCLEUS COLLISIONS. Goldhaber, A. S. (CERN, Geneva. State Univ. of New York, Stony Brook). Acta Phys. Pol.; B3: No. 1, 83-93(Jan-Feb 1972).

The optical formulation of high energy coherent reactions of elementary particles (elons) with nuclei is derived in an heuristic manner, which nevertheless competes in rigor with extant presentations of the subject. The formalism is applied to elastic scattering on nuclei, including the possibility of collective low-lying nuclear excitations. Coherent production of ρ and A mesonic states is discussed. Reliability of the nucleus as a measuring tool for elon attenuation is emphasized, and many corrections to the simplest approximation are examined. An approximate treatment of inelastic shadowing is given, and the speculation put forth that at very high energies there might be eigenstates of indefinite

multiplicity which suffer anomalously low attenuation in nuclear matter. (auth)

26616 PHYSICAL STATES, SPURIOUS STATES, AND PROJECTION OPERATOR IN DUAL RESONANCE MODEL. Kenmoku, Masakatsu; Yamada, Mitsuru (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1849-63(Dec 1971).

Physical states of each mass level of the dual resonance amplitudes are completely characterized. Ghost states in the physical states are extracted from the parent, the first daughter and the second daughter trajectories. There exist six particles with positive metric and only one particle with negative metric at each level on the second daughter trajectory. Some geometric properties of the projection operators are studied. The investigations are made throughout for general cases where $\alpha(0) < 0$. (auth)

26617 GROUP-THEORETICAL STRUCTURE OF THE DUAL RESONANCE MODEL. Akama, Keiichi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1869-84(Dec 1971).

Using the zeroth-mode oscillator method, it is shown that the basic operators in the dual resonance model can be written in terms of a non-unitary, local representation of SL(2,R) with reflections. The representation is that of the limit $\lambda \to -0$, where $\lambda(\lambda + 1)$ is an eigenvalue of the Casimir operator $-T_1^2 + T_2^2 + T_3^2$. The momentum dependence is eliminated from the basic operators, so that the calculation is considerably simplified. Lovelace's simple N-Reggeon vertex is reobtained unambiguously. (auth)

26618 INCLUSIVE REACTIONS IN THE REGGE POLE MODEL AND DUALITY. Hara, Y. (Tokyo Univ. of Education). Lett. Nuovo Cim.; 3: No. 13, 567-70(25 Mar 1972).

An attempt is made to derive all possible sum rules for the processes of the type $a + p \to \pi^+(\pi^-) +$ anything by assuming the Regge pole model and duality. The sum rules are compared with experimental results. The dependence of amplitudes in exotic channels on energy is also studied. (L.B.S.)

26619 SPIN-$\frac{1}{2}$ PARTONS IN A DUAL MODEL OF HADRONS. Aharonov, Yakir; Casher, Aharon; Susskind, Leonard (Tel-Aviv Univ., Israel). Phys. Rev., D; 5: No. 4, 988-94(15 Feb 1972).

Spin-$\frac{1}{2}$ partons are introduced into dual-parton theory. A nearest-neighbor antiferromagnetic interaction in longitudinal momentum is postulated and solved in the infinite-momentum frame. The resultant theory has a two-dimensional conformally invariant continuum limit and yields a dual theory of mesons and baryons which are magnonlike excitations of the spin lattice. For an even number of partons the model is equivalent to the Neveu–Schwarz meson theory. The odd-number case defines half-integer-spin states which are identified with baryons. The model is equivalent to a covariant model described previously. An important feature is the possibility of constructing current operators, although the gauge-invariance problem has not been solved yet. A major difficulty is the tachyonic nature of the "pion." Also, the nonspurious baryonic states have not yet been identified. (auth)

26620 DUAL-PION MODEL SATISFYING CURRENT-ALGEBRA CONSTRAINTS. Schwarz, John H. (Princeton Univ., N. J.). Phys. Rev., D; 5: No. 4, 886-91(15 Feb 1972).

The dual-pion model, previously constructed with $m_\pi^2 = -\frac{1}{2}$ and $m_\rho^2 = 0$, is generalized to arbitrary pion mass while maintaining the relation $m_\rho^2 = m_\pi^2 + \frac{1}{2}$. As in the conventional dual-resonance model, the price for doing this is the introduction of ghosts. In the special case $m_\pi = 0$, the N-pion amplitudes are shown to possess Adler zeros, and, as a consequence, to satisfy the constraints that current algebra imposes on on-mass-shell hadron amplitudes. The axial charges are explicitly constructed and shown to close with the isospin to form the algebra of SU(2) × SU(2). This model should provide a useful theoretical laboratory for studying the consequences of combining duality and current-algebra constraints. The construction of currents is a challenging problem. (auth)

26621 SELF-CONSISTENT QUARK MODEL. Rozenblit, Moshe (Stevens Inst. of Tech., Hoboken, N. J.). Phys. Rev., D; 5: No. 4, 876-85(15 Feb 1972).

A model is constructed in which the mass of the quark, two-quark, and quark-quark-antiquark states diverge while a quark and an antiquark and three quarks have finite-mass bound states. In this model the quarks are quark-meson bound states. All bound states are formed by a 4-fermion point interaction. For simplicity the static limit of the ladder approximation is used. (auth)

26622 TRANSITION OPERATORS IN AN ALGEBRAIC MODEL FOR HADRONS. Boehm, A. (Max-Planck-Institut fuer Physik und Astrophysik, Munich); Mainland, G. B. Phys. Rev., D; 5: No. 4, 872-6(15 Feb 1972).

Octets of vector and axial-vector operators are introduced to describe the transitions between one-hadron states in a previously described algebraic model. The properties of these operators under the discrete operations are investigated and used to predict the G parity for the particles of the I = 0 and I = 1 meson towers. (auth)

26623 TWO-PARTICLE DISCONTINUITIES OF ONE-LOOP GRAPHS IN THE DUAL-RESONANCE MODEL. Shapiro, Joel E. (Univ. of Maryland, College Park); Thorn, Charles B. Phys. Rev., D; 5: No. 4, 927-32(15 Feb 1972).

The two-particle discontinuities of the planar and nonplanar single-loop graphs are calculated for $s < 4(10-\alpha_0)$ BeV^2 for several values of the Regge intercept α_0, of the dimensionality D of the oscillators, and of the squared momentum transfer t. The results are not at all what was expected. (auth)

26624 NORMALIZABLE WAVE FUNCTIONS FOR BOUND STATES AND RESONANCES IN S-MATRIX THEORY. Kim, Y. S. (Univ. of Maryland, College Park); Vasavada, Kashyap V. Phys. Rev., D; 5: No. 4, 1002-11(15 Feb 1972).

Normalizable wave functions are constructed for bound states and resonances from the S-matrix quantities. The bound-state wave function is of the Schroedinger type. The Schroedinger equation does not give normalizable wave functions for resonances. Thus the resonance wave function is of the non-Schroedinger type. An S-matrix model is constructed to generate the desired resonance wave function. The manner in which this model departs from the conventional Schroedinger picture is discussed in detail. This S-matrix model is then applied to the P-wave two-pion system with a satisfactory numerical result for the ρ-meson radius. (auth)

26625 QUARK SPIN IN A DUAL-RESONANCE MODEL. Freund, P. G. O. (Imperial Coll. of Science and Tech., London. Univ. of Chicago). Nuovo Cim.; 8A: No. 3, 525-35(1 Apr 1972).

The foundations are laid for a dual-resonance model with a spectrum characteristic of $U_6 \times U_6 \times O_3$ symmetry. The model provides an automatic mechanism for the breaking of the collinear $U_6 \times O_2$ symmetry. The states on the leading Regge trajectory with the exception of the lowest ("ground") state are all parity doubled. It is aruged that there may exist "mesonic" strings with a quark at one end and an SU_3-singlet spin-zero boson at the other end. These complex hadrons would have all the quantum numbers (half-integer spin, nonvanishing triality, etc.) of quarks, while not being really quarks (e.g., a baryon would not be built of three of them). (auth)

26626 LIGHT-CONE COMMUTATORS IN THE NONPERTURBATIVE PARTON MODEL. Polkinghorne, J. C. (Cambridge Univ., Eng.). Nuovo Cim.; 8A: No. 3, 592-602(1 Apr 1972).

Light-cone commutators are calculated in the nonperturbative parton model. The results agree with those of Fritzsch and Gell-Mann, and Cornwall and Jackiw. The dynamically dependent terms found by the latter authors are identified and it is argued that they are absent in the softened theory under discussion. It is shown how the commutators lead to the same expressions for the deep inelastic structure functions as were obtained in the model previously by direct calculation. (auth)

26627 CALCULATION ON PHYSICAL PARTONS. De Azcarraga, J. A. (Cambridge Univ., Eng.). Nuovo Cim.; 8A: No. 3, 621-34(1 Apr 1972).

The Landshoff–Polkinghorne model for deep inelastic lepton scattering is considered in a context in which partons (quarks) are treated as physical particles. This approach is complemented by the hypothesis that the asymptotic behavior of the scaling function $F_2(\omega)$ for electroproduction is due to a diffractive mechanism for which a model is constructed. As a result, a value for the quark mass is found. (auth)

26628 BOUNDS ON PION MULTIPLICITIES AND FLUXES FROM ISOSPIN INVARIANCE. Honerkamp, J.; Muetter, K. H. (CERN, Geneva). Nucl. Phys.; B38: No. 2, 565-72(1972).

From isospin invariance lower and upper bounds are derived for π^0 multiplicities (fluxes) in terms of $\pi^\pm$ multiplicities (fluxes) for various processes like NN, $N\bar{N}$, KN and πN scattering. (auth)

26629 DYNAMICS AT INFINITE MOMENTUM. I. FORMALISM FOR FREE PARTONS. Osborn, H. (Cambridge Univ., Eng.). Nucl. Phys.; B38: No. 2, 429-65(1972).

By transformation of the canonical generators of the Poincaré group for a system of N free particles on a spacelike surface, dynamical variables and Poincaré group generators appropriate to the infinite momentum frame, or equivalently on a light like sur-

face, are derived. The separation of the cm motion is shown to follow simply from the Galilean, non-relativistic, structure of the Poincaré group in this frame, and the more complicated problem of introducing an interaction consistent with rotational invariance and preserving the number of particles is also solved. Currents for free particles are derived consistent with the necessary transformation properties and the current operators acting only on transverse variables so that they leave the vacuum invariant are studied. These free currents couple positive and negative energy states but the latter can possibly be reinterpretated as representing antiparticles. It is shown how the Dashen Gell-Mann angular condition may be obtained as an operator condition, without any reference to particle states. The magnetic moment of a point elementary particle of arbitrary spin is suggested by these equations to be $\mu = eS/M$. The preceding formalism is used to derive the free parton model for deep inelastic electron scattering and it is shown to be consistent with light cone commutators. The $J = 0$ fixed pole in the amplitude whose imaginary part is $W_2(\nu,Q^2)$ is examined in this framework and found to be related to a Schwinger term in a certain commutator. (auth)

26630 FINAL STATE SPECTRA IN A MULTIPERIPHERAL MODEL. Pinsky, Stephen (Univ. of Utah, Salt Lake City); Weisberger, William I. Ann. Phys. (N. Y.); 70: No. 1, 268-85(Mar 1972).

Using an integral equation technique based on the multiperipheral model, various properties of the spectrum of secondaries in high-energy inelastic collisions are studied. From the basic properties of the multiperipheral model, several results about single particle momentum spectra, and multiplicity of secondaries are derived. An extension of the method to multiparticle correlations is initiated by calculating the average invariant mass of neighbors on the multiperipheral chain. (auth)

26631 BROKEN CHIRAL SYMMETRY, TADPOLE MODEL AND SCALAR MESONS. Dutt, Ranabir; Eliezer, Shalom (Technion-Israel Inst. of Tech., Haifa). Particles Nucl.; 2: No. 2, 61-73(Aug 1971).

Assuming scalar and pseudoscalar meson dominance for the saturation of certain sum rules, it is shown that the broken chiral SU(3) ⊗ SU(3) symmetry model of Gell-Mann, Oakes and Renner corresponds to a special form of the dynamical tadpole model of Coleman and Glashow. The smoothness assumption is imposed on certain three-point vertex functions to obtain sum rules between the coupling constants. The symmetry-breaking parameters and the mass of the K-meson are determined in terms of known masses and one input variable $F = f_K/f_\pi$. The tadpole results are reproduced with $F \approx 1.28$ which gives $m_K \approx m_{\pi N} \approx 1020$ MeV. (auth)

26632 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON DUALITY AND SYMMETRY IN HADRON PHYSICS. Conference Held at Tel Aviv, Israel, April 5-7, 1971. Gotsman, E. (ed.). Jerusalem; Weizmann Science Press of Israel (1971). 425p. $14.50. (CONF-710453).

Separate abstracts are prepared for the ten papers included. Also included in the proceedings are abstracts of thirty-nine contributed papers. (L.B.S.)

For abstracts of individual papers see: 26586, 26587, and 26633–26640.

26633 DUALITY AND EXCHANGE DEGENERACY IN HIGH-ENERGY PHENOMENOLOGY. Jackson, J. D. (Univ. of California, Berkeley). pp 1-59 of Proceedings of the International Conference on Duality and Symmetry in Hadron Physics. /Gotsman, E. (ed.). Jerusalem; Weizmann Science Press of Israel (1971).

From Conference on duality and symmetry in hadron physics; Tel Aviv, Israel (5 Apr 1971).

A status report is given on duality in its application to collision processes at intermediate and high energies, which includes some examples of directions in which experiment and theory are going. Topics discussed include exotic resonances and exotic exchanges; analysis of three-body sequential decays of mesons; tests of duality and exchange degeneracy; study in duality by means of FESR; phenomenological models and duality; and duality in inclusive experiments. (L.B.S.)

26634 MANY PARTICLE PHENOMENA. Horn, D. (Tel-Aviv Univ., Israel). pp 60-97 of Proceedings of the International Conference on Duality and Symmetry in Hadron Physics. /Gotsman, E. (ed.). Jerusalem; Weizmann Science Press of Israel (1971).

From Conference on duality and symmetry in hadron physics; Tel Aviv, Israel (5 Apr 1971).

The general properties of multiparticle production processes are first discussed. Other topics include the multiperipheral model, simple dynamics and kinematics, distributions in momentum space, scaling and limiting fragmentation, Reggeistic approach to inclusive distributions, and two-particle correlations. (L.B.S.)

26635 PARTONS. Bjorken, James D. (Stanford Univ., Calif.). pp 98-115 of Proceedings of the International Conference on Duality and Symmetry in Hadron Physics. /Gotsman, E. (ed.). Jerusalem; Weizmann Science Press of Israel (1971).

From Conference on duality and symmetry in hadron physics; Tel Aviv, Israel (5 Apr 1971).

The parton idea is first illustrated by using the example of quantum electrodynamics, where high energy scattering from external fields is simply described by expanding the incoming state in terms of wavefunctions for configurations of partons. The second part is concerned with the nature of such wave functions for hadrons. Models are discussed such as Feynman's dx/x mixture of partons, multiperipheral wave functions, and an oscillator wave function which produces something like the Veneziano formula. Applications are then made to deep-inelastic processes. (L.B.S.)

26636 PHENOMENOLOGICAL DUALITY. Harari, Haim (Stanford Univ., Calif. Weizman Inst. of Science, Rehovot, Israel). pp 148-78 of Proceedings of the International Conference on Duality and Symmetry in Hadron Physics. /Gotsman, E. (ed.). Jerusalem; Weizmann Science Press of Israel (1971).

From Conference on duality and symmetry in hadron physics; Tel Aviv, Israel (5 Apr 1971).

A summary is given on the results of work on duality and phenomenological studies of hadron reactions. The framework of two-component duality, the elastic and inelastic angular distributions of hadron two-body reactions, duality and peripheral s-channel resonances, and absorption is first discussed. A qualitative model is constructed and compared with experimental data for elastic differential cross sections, elastic polarizations, and dips in inelastic reactions. Several open problems are listed in conclusion. (L.B.S.)

26637 PROGRESS IN THE THEORY AND APPLICATION OF DUAL MODELS. Veneziano, G. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. pp 179-223 of Proceedings of the International Conference on Duality and Symmetry in Hadron Physics. /Gotsman, E. (ed.). Jerusalem; Weizmann Science Press of Israel (1971).

From Conference on duality and symmetry in hadron physics; Tel Aviv, Israel (5 Apr 1971).

A new approach to unitarization of dual models is presented and analyzed in detail. The approach is based on the hypothesis that the Born approximation is not too far from reality if its most obvious defects can be remedial, and on the assumption that the dual resonance model has narrow resonances. The main results of the scheme are outlined and discussed. (L.B.S.)

26638 SPIN AND UNITARITY IN DUAL RESONANCE MODELS. Virasoro, M. A. (Univ. of California, Berkeley). pp 224-51 of Proceedings of the International Conference on Duality and Symmetry in Hadron Physics. /Gotsman, E. (ed.). Jerusalem; Weizmann Science Press of Israel (1971).

From Conference on duality and symmetry in hadron physics; Tel Aviv, Israel (5 Apr 1971).

The discussion is concerned with recent developments in the program to build a theory of hadrons using as a starting point the generalized Veneziano model and treating it as a Born approximation to a Feynman-like series that implement unitarity in a perturbative way. The topics discussed include a review of the formalism, ghosts, and conformal invariance; a multiplicative quark model with spin orbit coupling, conformal invariant Lagrangians for spinor fields; and the unitarization program. (L.B.S.)

26639 REVIEW OF HADRON SPECTROSCOPY. Meshkov, Sydney (National Bureau of Standards, Washington, D. C.). pp 252-316 of Proceedings of the International Conference on Duality and Symmetry in Hadron Physics. /Gotsman, E. (ed.). Jerusalem; Weizmann Science Press of Israel (1971).

From Conference on duality and symmetry in hadron physics; Tel Aviv, Israel (5 Apr 1971).

A brief history is given of the A_2 splitting problem. The classification of mesons in the $q\bar{q}$, L picture is then presented. The kinds of configuration mixing expected in the usual SU(6) × U(3) classification of baryons are reviewed, and the baryon spectra are discussed in detail. (L.B.S.)

26640 WHERE TO DUALITY? pp 375-96 of Proceedings of the International Conference on Duality and Symmetry in Hadron

Physics. /Gotsman, E. (ed.). Jerusalem; Weizmann Science Press of Israel (1971).

From Conference on duality and symmetry in hadron physics; Tel Aviv, Israel (5 Apr 1971).

A panel discussion on duality is presented, which is centered around the following topics: the relation of duality to the bootstrap program, symmetry patterns of quarks, the tree form of duality, the duality program with loops, methods of introducing spin in the duality program, MacDowell degeneracy, and the Pomeranchuk singularity in duality theory. (L.B.S.)

Strong (Baryon No. = 0)

Refer also to abstracts 26308, 26522, and 26712.

26641 VIRASORO MODEL AND DUALITY. Kennedy, W. L.; Oh, C. H. (Univ. of Otago, Dunedin, New Zealand). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1864-8(Dec 1971).

An integral representation for the Virasoro amplitude is used to split the amplitude into two terms, one of which being only meromorphic in $\alpha(s)$ contains the s-channel resonances while the other of which being entire in $\alpha(s)$ contains no s-channel resonances, dominates the first at high energies, and gives the complete Regge behavior. A similar analysis is carried out for the Mandelstam–Veneziano amplitude with doubly spaced trajectories. Both these amplitudes are thus shown not to satisfy strong duality; the implications are briefly discussed. (auth)

26642 DUAL N-PION AMPLITUDE. Sukhatme, U. P. (Univ. of Washington, Seattle). Lett. Nuovo Cim.; 3: No. 13, 537-40(25 Mar 1972).

The N-point pion amplitude proposed by Neveu and Schwarz is discussed and is modified by the removal of all operators. The results explicitly display the duality properties (projective invariance) and cyclic symmetry of the amplitude. (L.B.S.)

26643 UNIQUENESS OF AMPLITUDES SATISFYING THE MANDELSTAM REPRESENTATION. Cheung, Franklin F. K. (Univ. of Notre Dame, Ind.); Chen-Cheung, Fei Shian. Phys. Rev., D; 5: No. 4, 970-80(15 Feb 1972).

It is shown that within the framework of the Mandelstam representation, the scattering amplitudes, if they exist, are uniquely determined by the absorptive parts over the elastic region of one channel. It is illustrated in detail with pion-pion and pion-nucleon scattering. (auth)

26644 COMMENTS ON THE $\pi\pi$ MODEL OF KANG AND LEE. Tryon, E. P. (Columbia Univ., New York). Phys. Rev., D; 5: No. 4, 1039-43(15 Feb 1972).

The model for low-energy $\pi\pi$ amplitudes proposed recently by Kang and Lee is analyzed and shown to violate analyticity and/or crossing symmetry, and also Regge sum rules for S- and P-wave scattering lengths. Possible reasons for these violations are discussed, and the outline is given of an argument which indicates that the ρ meson is not a dynamically bound state of two π mesons. (auth)

26645 SOME DIFFICULTIES WITH THE USE OF THE KEMMER–DUFFIN FORMALISM FOR PSEUDOSCALAR MESONS. Deshpande, Nilendra G.; McNamee, Peter C. (Northwestern Univ., Evanston, Ill.). Phys. Rev., D; 5: No. 4, 1012-4(15 Feb 1972).

While the Kemmer–Duffin formalism for pseudoscalar mesons eliminates some difficulties in the analysis of K_{l3} form factors, it gives rise to difficulties in other areas. It is shown that this formalism leads to: (i) a linear Gell–Mann–Okubo mass formula for mesons; (ii) an incompatibility between SU(3)-symmetric meson-nucleon couplings and experiment; (iii) (3*,3) breaking of chiral symmetry ($H' = u^0 + cu^8$) leads to $c = -0.9$ and $f_K/f_\pi = (m_\pi/m_K)^{1/4}$. (auth)

26646 DUAL AMPLITUDE WITH ARBITRARY TRAJECTORIES. Ramachandran, R.; Taha, M. O. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev., D; 5: No. 4, 1015-18(15 Feb 1972).

A crossing-symmetric amplitude with Regge behavior is proposed. With arbitrary Regge trajectories, it avoids ancestor and ghost difficulties and possesses second-sheet resonances which may be finite in number. The N-point and $\pi\pi$ amplitudes are given. (auth)

26647 DUAL MODEL FOR N–N AND N–$\bar{N}$ SCATTERING. Joshi, G. C. (Rutgers–The State Univ., New Brunswick, N. J.); Pagnamenta, Antonio. Particles Nucl.; 1: No. 3, 220-7(Dec 1970).

A dual amplitude for N–N and N–$\bar{N}$ scattering is proposed on the basis of duality diagrams and the quark model. The representation is constructed from three sets of meson ($Q\bar{Q}$) trajectories and three sets of exotic meson ($QQQ\bar{Q}$) trajectories. In each of these sets trajectories are exchange degenerate. It is shown that the exotic trajectories do not contribute to the charge exchange N–N (and N–$\bar{N}$) scattering in the t-channel. The model provides simultaneously a good fit to the essential features of the differential cross sections of $np \to pn$ and $p\bar{p} \to n\bar{n}$. (auth)

26648 HELICITY AMPLITUDES FOR ANTIBARYON–BARYON SCATTERING. I. Weiner, Richard M. (Indiana Univ., Bloomington). Particles Nucl.; 3: No. 3, 140-56(Mar 1972).

The expressions for helicity amplitudes for the reaction $\bar{p}p \to \bar{p}p$ are given in terms of quark helicity amplitudes assuming the scattering mechanism described previously. These expressions can be used in order to compute density matrix elements in antibaryon–baryon scattering. (auth)

26649 RADIUS OF THE ELEMENTARY PARTICLES π, p AND ANALYTICAL PROPERTIES OF THE FORM FACTOR. Baluni, V. Z. (Moscow State Univ.). Teor. Mat. Fiz.; 10: No. 1, 19-32 (Jan 1972). (In Russian).

Based on the analytical properties of the electromagnetic form factor, the upper and the lower bounds on the mean square radius of the elementary particles are established by two different methods. The first method uses the experimental distribution of the form factor modulus in the annihilation channel. The second method uses in addition to this the experimental value of the form factor in a certain space-like point. Within experimental errors both methods give the same result for the π-meson rms radius ($r_\pi = 0.7 \pm 0.15$ F). The upper and lower bounds on the proton rms radius are also obtained (0.7 ± 0.12 F $\leq r_p \leq 1.05 \pm 0.06$ F). (auth)

26650 DETERMINATION OF EXCHANGE FORCES IN THE $\pi\pi$P WAVE. Tryon, E. P. (Hunter Coll., New York). Phys. Lett.; 38B: No. 7, 527-31(3 Apr 1972).

A new representation is derived for the $\pi\pi$P wave. This representation enables the second and all higher negative moments of the discontinuity across the left cut to be computed strictly in terms of physical-region absorptive parts. N/D solutions for the P wave are constructed, using a model for the left cut which incorporates generous estimates for the second, third, and fourth negative moments. It is found that despite generosity of the estimates, the left cut is too weak to generate a resonance when elastic unitarity is assumed, and also when the possibility of substantial inelasticity is taken roughly into account. It is concluded that the ρ resonance is due either to presently unknown details of the inelasticity, or to a bound state in some other channel. (auth)

26651 GAUGE-INVARIANT CHIRAL LAGRANGIAN AND $\bar{p}p$ ANNIHILATIONS. Chiang, C. C. (Syracuse Univ., N. Y. Univ. of Texas, Austin). Nuovo Cim.; 8A: No. 3, 501-19(1 Apr 1972).

Two-meson production processes in $\bar{p}p$ annihilation at rest in a gauge-invariant, chiral $SU_3 \times SU_3$ symmetric Lagrangian model are investigated. The gauge field has been identified as the massive vector field which is decomposed into the ρ octet and the ρ' octet. Both S-wave and P-wave annihilations are computed. The result is compatible with the most recent experimental data. The possible contribution from higher integer spin dominance is also discussed. (auth)

26652 GENERALIZED VENEZIANO MODEL FOR PION SCATTERING OFF ISOVECTOR CURRENTS AND THE SCALING LIMIT. Rothe, H. J. (CERN, Geneva); Rothe, K. D.; Dahmen, H. D. Nuovo Cim.; 8A: No. 3, 649-69(1 Apr 1972).

Starting from a local one-particle approximation scheme for the commutator of two conserved currents, a generalized Veneziano model is constructed for pion scattering off neutral and charged isovector currents, satisfying the constraints of current conservation and current algebra. The model factorizes correctly on the leading Regge trajectories and incorporates the proper Regge behavior for strong amplitudes. Fixed poles are found to be present in the s and t channels of the one- and two-current amplitudes. Furthermore, the model makes definite predictions about the structure of Schwinger terms and of the "seagull" terms in the retarded commutator. An investigation of the deep inelastic limit shows that the Bjorken scaling behavior may be obtained by a proper choice of parameters. (auth)

26653 RIGOROUS SPIN TESTS FROM USUAL STRONG DECAYS. Doncel, M. G. (Univ. Automoma, Barcelona); Michel, L.; Minnaert, P. Nucl. Phys.; B38: No. 2, 477-528(1972).

Applying a geometrical formalism, a general study is made of angular momentum and parity conservation in the most frequent two body strong decays, in order to propose new tests for the determination of the spin of the decaying particle. (auth)

26654 SPLITTING IN THE A_2 MESON. MacGregor, Malcolm H. (Univ. of California, Livermore). Particles Nucl.; 1: No. 8, 473-84(May 1971).

Recent experiments show splitting of the A_2 meson in all charge states and decay modes. Analysis of the data indicates comparable but incoherent I = 0 and I = 1 amplitudes. Hence a new interfering resonance, X(1310 MeV)Γ 15 MeV, spin 2, which is not predicted by the quark model, seems required to explain the splitting. A model is presented that gives the X correctly. It also accounts for several unidentified low-mass resonances, including a spin 1 σ resonance. (auth)

26655 RESONANCE AMPLITUDES IN THE TAIL REGION. Deans, S. R.; Jacobs, D. T. (Univ. of South Florida, Tampa). Particles Nucl.; 1: No. 7, 446-9(Apr 1971).

The Breit-Wigner resonance forms generally have tails that are too long for the observed resonances in high energy physics. A possible explanation for some of the difficulty and a possible modification of the amplitude in the region of the tail are presented. (auth)

26656 QUARK MODEL FOR $\bar{p}N \rightarrow PV$ ANNIHILATIONS AT REST. Chand, Ramesh (Univ. of Texas, Austin. Himachal Pradesh Univ., Simla, India). Particles Nucl.; 3: No. 2, 69-78 (Feb 1972).

In an SU(3) symmetric quark model, the at rest annihilations $\bar{p}N \rightarrow PV$ are investigated. It is assumed that the physical baryon octet contained in $3 \otimes 3 \otimes 3$ is given by: 8 (physical) = 8′ $\cos\theta$ + 8 $\sin\theta$, where 8 and 8′ octets arise from $3 \otimes \bar{3}$ and $3 \otimes 6$, respectively. The results are found to be in reasonable agreement with the available experimental data on these processes. (auth)

26657 SATELLITE PEAKS OF THE A_2 MESON. MacGregor, Malcolm H. (Univ. of California, Livermore). Particles Nucl.; 2: No. 6, 358-75(Dec 1971).

It is pointed out that $A_2 \rightarrow \pi\pi\pi$ measurements which show (do not show) an A_2 dip also show (do not show) narrow satellite peaks at 1080 and 1150 MeV. This result is of importance in establishing a mechanism for splitting the A_2 meson. (auth)

Strong (Baryon No. = 1)

Refer also to abstract 26732.

26658 POSSIBLE SCHEME FOR LEADING BARYON TRAJECTORIES AND TEST OF THE PREDICTIONS OF DUALITY DIAGRAMS FOR THE FORWARD $K^-p \rightarrow \pi^-\Sigma^+$ REACTION AMPLITUDE. Matsumoto, Yoshihiro; Minami, Shigeo (Osaka City Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1770-80(Dec 1971).

A possible scheme is proposed for the baryon trajectories which have large effects on the description of meson-baryon scattering at high energy. Based on the model, the amplitudes for the forward $K^-p \rightarrow \pi^-\Sigma^+$ reaction are studied in order to test the predictions of duality diagrams that cannot be derived from the simple duality concept. It is shown that the predictions are not inconsistent with the results obtained by estimation of the direct-channel resonant amplitude. (auth)

26659 VIRASORO MODEL AND πN SCATTERING. Hori, Setusko; Kawaguchi, Norio (Osaka Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1781-93(Dec 1971).

The Virasoro representation is investigated for pion-nucleon charge exchange scattering. Our Virasoro model consists of particular combinations of the Regge trajectories exchanged in the s, t and u channels. Here, only the amplitudes which show the leading asymptotic behavior are taken into account. No ambiguous satellite terms are considered. The forward and the backward differential cross sections, an effective Regge trajectory, polarization of the final neutron and imaginary parts of the amplitudes at t = 0 are calculated and compared with experiment. As a result, a fairly good agreement with experiment can be obtained. Based on the Virasoro model, other hadron collisions are also discussed in connection with a dip at $|t| \simeq 0.6$ (auth)

26660 DUAL AMPLITUDE AND STRANGE FORM FACTORS. Chowdhury, A. Roy; Banerjee, S. N. (Jadavpur Univ., Calcutta). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1794-8(Dec 1971).

The Veneziano model for $\pi N \rightarrow K\Lambda$ was used to investigate the structure of Λ-particle. The imaginary parts of the form-factors (both electric and magnetic) are found to be dominated by a strong $K^*(\pi K)$ resonance. The ratio of the form-factors near this resonance is in accord with other theoretical estimates. (auth)

26661 POMERANCHUK THEOREMS FOR INCLUSIVE REACTIONS NEAR THE BOUNDARY OF PHASE SPACE. Mickens, R. E. (Fisk Univ., Nashville). Lett. Nuovo Cim.; 3: No. 13, 578-80(25 Mar 1972).

The consequences of analyticity in energy and crossing for the inclusive reactions p + N → missing mass + N and $\bar{p}$ + N → missing mass + N near the boundary of phase space are studied. Pomeranchuk-type theorems for related processes are derived. (L.B.S.)

26662 SOME CONSEQUENCES OF SPIN CONSERVATION. Takagi, Fujio (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1938-40(Dec 1971).

Some consequences of s-channel spin conservation are examined for $0^- - 1/2^+$ elastic scattering at high energies, assuming that the pomeron and the possible additional terms with even signature obey spin conservation. The following conclusions are reached: The pomeron should decouple from the A amplitude. There must be a conspirator P_c such that $\alpha_{P_c}(t) = \alpha_P(t) - 1/2$ for $t_L \leq t \leq 0$. Only the imaginary part of the pomeron and the P_c terms can satisfy the s-channel spin conservation. (L.B.S.)

26663 RELATIVISTIC OPTICAL MODEL FOR PION–NUCLEON SCATTERING. Best, Melvyn E. (McGill Univ., Montreal, Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Ann. Phys. (N. Y.); 69: No. 2, 400-27 (Feb 1972).

A theoretical study of pion-nucleon scattering for pion laboratory momentum between 2 and 5 GeV/c was made by generalizing the nuclear optical model. The Bethe–Salpeter equation for pion-nucleon scattering via the simultaneous exchange of a scalar-isoscalar particle and a vector-isovector particle (ρ) was derived in the ladder approximation. The corresponding Blankenbecler–Sugar equation was then derived and a relativistic optical potential was obtained by allowing the coupling constants to become complex. Of the 6 parameters in the optical potential (the masses of the two particles and the real and imaginary parts of the product of the coupling constants for the two particles) only the imaginary part of the scalar coupling was energy dependent. The other coupling parameters were fixed by fitting the data at a pion laboratory momentum of 4 GeV/c. The ρ mass was fixed at its experimental value of 765 MeV. To fit the forward diffraction peak an isoscalar mass of 450 MeV was needed. Using these parameters good fits to the total and elastic cross sections and the $\pi^\pm - p$ elastic differential cross sections for $t \lesssim 1.5$ $(GeV/c)^2$ were obtained. While fits to the differential charge exchange cross sections and the ratio of the real to imaginary part of the forward scattering amplitude were in reasonable agreement with experiment, the polarizations only agreed qualitatively. A discussion of the significance of the results and of possible extensions to the above theory is presented. (auth)

26664 FEYNMAN-DIAGRAM MODELS OF FERMION REGGE-POLE CONSPIRACIES. Robertson, David C. (Univ. of Oregon, Eugene). Phys. Rev., D; 5: No. 4, 942-9(15 Feb 1972).

A Feynman-diagram model of spin-J fermion Regge poles is developed for meson-nucleon scattering and is used to study the conspiracies arising from two types of Lorentz-invariant couplings. For a completely symmetric coupling, the model automatically leads to a conspiracy relation (M = 1/2) between two leading trajectories of opposite parity which are MacDowell partners. The second type of coupling, which is antisymmetric in two indices, leads to an M = 3/2 conspiracy relation between four leading trajectories. At high energies, the M = 1/2 conspiracy favors the scattering of spin-1 mesons with zero helicity in both initial and final states while the M = 3/2 conspiracy favors mesons of helicity ±1. Since the M = 3/2 trajectory chooses nonsense coupling at J = 1/2, the lowest spin of a particle on the trajectory is 3/2. (auth)

26665 DUAL MODEL FOR A_1 PRODUCTION. Poe, Robert Franklin. San Diego, Calif.; Univ. of California (1971). 70p. University Microfilms Order No. 72-9838.

Thesis.

A dual-resonance model is constructed for the reaction $\pi N \rightarrow \rho\pi N$, accounting for the spin of the rho meson while neglecting that of the nucleons. Both diffraction dissociation and Regge exchange are included at the $N\bar{N}$ vertex. Thirteen different charge configurations are considered. The model cross sections are integrated over phase space to yield distributions in the pi–rho mass for the A_1 region. It is found that the Deck effect is greatly suppressed in the dual model. Comparisons are drawn with experiments and with other models, and the implications of duality in multi-particle reactions are discussed. Conclusions favor the interpretations of Chew and Pignotti. (Diss. Abstr. Int., B)

26666 STUDY OF THE REACTION $\pi^-p \to \pi^+\pi^-n$ USING THE VENEZIANO FIVE POINT FUNCTION. Lavelle, John William. San Diego, Calif.; Univ. of California (1971). 109p. University Microfilms Order No. 72-6461.

Thesis.

A generalized one-pion-exchange model for the reaction $\pi^-p \to \pi^+\pi^-n$ is developed using the five point function of Bardakei and Ruegg. The model, cleanly formulated and using the slope of the π trajectory as the only parameter, is thoroughly investigated. It is shown how the K-matrix unitarization scheme for mesons may be carried over to a production process, and the behavior of the model is observed over a wide range of energy for variations of all four remaining independent variables. The results are in general agreement with experiment, suggesting that the formulation is a desirable improvement over extant phenomenology describing the reaction. (Diss. Abstr. Int., B)

26667 CHN ANALYSIS OF THE SERPUKHOV TOTAL CROSS-SECTION DATA. Horwitz, L. P. (Univ. of Denver); Ne'eman, Y. Particles Nucl.; 1: No. 3, 185-97(Dec 1970).

The energy dependence required of the CHN amplitudes by the Serpukhov data is studied. The behavior of the singlet even amplitude is found to have a break. There may be systematic errors in the new data, but it appears that the universal couplings provided by CHN, with essentially the same D/F found at lower energies for the baryon even amplitude couplings, still provide a consistent interpretation. (auth)

26668 COMPARISON OF RESONANCE AND REGGE MODELS FOR BACKWARD PION–NUCLEON SCATTERING AT INTERMEDIATE ENERGIES. Tomlinson, P. G.; Crittenden, R. R.; Heinz, R. M.; (and others) (Indiana Univ., Bloomington). Particles Nucl.; 1: No. 2, 169-82(Nov 1970).

Cross sections and polarizations in π^+p backward elastic scattering from the Regge exchange model of Berger and Fox are applied to the region $2.38 \leq p_{lab} \leq 5.0$ GeV/c. The resulting amplitudes are then compared to those of a direct-channel resonance model which also gives qualitative agreement with the data. It is then observed that, with few exceptions, the Regge amplitudes exhibit an angular dependence and phase which are similar to those of the resonance amplitudes. Also the energy-dependence of the Regge amplitudes is somewhat of an "average" of the resonance amplitude. The results give qualitative support to the concept of duality in π^+p scattering. (auth)

26669 SIGMA MODEL. Gammel, J. L. (Los Alamos Scientific Lab., N. Mex.). Particles Nucl.; 1: No. 5, 321-35(Feb 1971).

A sigma model which results in precise baryon (n, p, Λ, Σ^+, Σ^0, Σ^-, Ξ^-, Ξ^0) and meson (π^+, π^0, π^-, K^+, K^0, $\bar{K}^0$, K^-, η) masses and which yields PCAC relations in accurate agreement with experiment is described. (auth)

26670 CONSTRAINTS ON HELICITY AMPLITUDES FROM ANALYTICITY, CROSSING SYMMETRY, AND UNITARITY. Case, William Bleicher. Syracuse, N. Y.; Syracuse Univ. (1971). 73p. University Microfilms Order No. 72-6563.

Thesis.

Using crossing symmetry, an infinite number of sum rules are derived for the scattering process a + b → c + d, where a, b, c and d are particles of arbitrary spins and masses. Each sum rule involves only a finite number of partial waves of helicity amplitudes while the entire set of relations expresses the complete content of crossing symmetry. For the elastic scattering of particles with arbitrary masses and spins, unitarity demands that a certain combination of helicity amplitudes obey a positivity condition. This positivity condition is applied to a fixed t dispersion relation to give an inequality involving a finite number of partial waves of helicity amplitudes in the t-channel ($a + \bar{a} \to b + \bar{b}$). This relation is then projected into the s-channel ($a + b \to a + b$) where it gives a second inequality involving an integral over a finite number of partial waves of s-channel helicity amplitudes. The resulting inequalities are given in detail for the case of pi-nucleon scattering. (Diss. Abstr. Int., B)

26671 P.C.A.C. CONSISTENCY CONDITION FOR THE PROCESS $\pi^- + p \to \pi^- + D_{13}^+$. THE $\pi D_{13}D_{13}$ COUPLING CONSTANT. Bellandi F., J. (Instituto de Fisica Teorica, Sao Paulo, Brazil). An. Acad. Brasil. Cienc.; 43: No. 2, 369-71(30 Jun 1971).

A PCAC consistency condition is established for the process $\pi^-p \to \pi^- D_{13}^+$ from which the $\pi D_{13}D_{13}$ coupling constant is estimated. The value obtained is consistent with previous determinations. (auth)

26672 THRESHOLD CONSTRAINTS IN A REGGE POLE MODEL OF THE REACTION $\pi N \to \rho\,\Delta(1236)$. Fagundes, Helio (Instituto de Fisica Teorica, Sao Paulo, Brazil). An. Acad. Brasil. Cienc.; 43: No. 2, 357-67(30 Jun 1971).

Threshold and psuedothreshold constraints for the process $\pi N \to \rho\,\Delta$ are explicitly presented. A Regge pole model of this reaction is obtained, which illustrates, and takes advantage of, use of the pseudothreshold constraints; this provides for less arbitrariness in the Regge pole parametrization. The model is based on the contributions of (nonconspiring) π, A_1, and A_2 trajectories. The same reaction serves also as working ground for some formal considerations regarding Regge pole theory, in particular Jackson and Hite's method of reggeization. A fit of data from the reaction $\pi^+p \to \rho^0\,\Delta^{++}$ at 8 GeV/c incident momentum is performed. (auth)

26673 TOTAL SCATTERING CROSS SECTIONS IN TWO BODY STRONG INTERACTIONS CALCULATED BY AN ALGEBRAIC APPROACH USING THE GROUP SU(4). Kalman, Calvin S. (Loyola Coll., Montreal). Particles Nucl.; 2: No. 4, 186-200(Oct 1971).

A method developed for the calculation of total scattering cross sections in two body strong interactions by an algebraic approach using the group SU(1,3) is applied to the group SU(4). Total cross sections for a total of ninety five events based on eight parameters are predicted. Only nineteen of these have been experimentally measured. Of these, seven consist of too few experimental measurements to be used. Nonetheless the results do not seem to correspond to the experimental situation. It would seem that the correct choice of dynamical group is the group SU(1,3), since with that group an order of magnitude agreement with experiment is achieved. (auth)

26674 COUPLING CONSTANTS OF THE ISOSCALAR VECTOR MESONS TO THE NUCLEON AND DISPERSION-THEORETIC SUM RULES. Bhaumik, K.; Babapundari, S.; Dutta-Roy, B. (Saha Inst. of Nuclear Physics, Calcutta). Nuovo Cim.; 8A: No. 3, 473-84(1 Apr 1972).

From sum rules based on dispersion relations and the use of threshold identities, constraints on the coupling constants of the isoscalar vector mesons to the nucleon are derived. For this purpose a combination of kaon-nucleon amplitudes is considered, which corresponds to $I^G = 0^-$ in the t-channel, and which may be taken in this channel to be dominated by the ω and φ exchanges. These sum rules, being based on rather general principles, as compared to most other model-dependent analyses, provide a comparatively more reliable tool. On the one hand, the consistency of various speculations about these coupling constants can be checked and, on the other hand, these quantities can be estimated and compared with other determinations and observations. (auth)

26675 PHENOMENOLOGICAL DUAL DESCRIPTION OF THE REACTIONS $K^+p \to K^{*0}\pi^+p$ AND $K^-p \to \bar{K}^{*0}\pi^-p$. Papageorgiou, S. (Democritus Nuclear Research Center, Athens). Nuovo Cim.; 8A: No. 3, 635-48(1 Apr 1972).

The reactions $K^+p \to K^{*0}\pi^+p$ and $K^-p \to \bar{K}^{*0}\pi^-p$ are studied with a dual five-point amplitude. An appropriate kinematical factor suitable for six-particle systems is used. The pomeron-exchange contribution is excluded. With the help of the longitudinal phase-space analysis the kinematical domain of the model is defined and a suitable selection of the data is performed. An overall agreement (characteristic of the phenomenological dual-vector model) is obtained. (auth)

26676 LIMITING FRAGMENT DISTRIBUTIONS OF INCLUSIVE REACTIONS. Roy, D. P.; Roberts, R. G. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Phys.; B38: No. 2, 587-92(1972).

Using the hypothesis of limiting fragmentation the longitudinal momentum dependence of inclusive reactions at fixed s is related to the energy dependence of quasi-two-body inelastic cross sections. The essential features of the longitudinal distributions are shown to be simple consequences of the familiar rise near threshold and subsequent fall off at high energies of a quasi-two-body cross section. (auth)

26677 THEORETICAL MODEL-INDEPENDENT DETERMINATION OF ZEROS OF THE K^-p FORWARD SCATTERING AMPLITUDES. Dumbrais, O. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; B38: No. 2, 600-4(1972).

The locations of zeros of the K^-p forward scattering amplitudes are calculated by means of the analytical continuation of the scattering amplitude parametrized in the physical region to complex values of the energy. The method exploits the known analyticity properties of the scattering amplitude and experimental data in a limited energy range. However, unlike conventional dispersion relation calculations, it requires no assumptions about the residues of the hyperon pole terms and the amplitudes in the unphysical and asymptotic regions. (auth)

26678 ON THE P_T DISTRIBUTION. Hoang, T. F. (Argonne National Lab., Ill.). Nucl. Phys.; B38: No. 2, 333-49(1972).

A discussion is given on crucial tests for the Hagedorn and the Boltzmann distributions for P_T. Applications to the high energy π^-p and pp experiments of Wisconsin and Berkeley justify the use of the Hagedorn distribution and rules out the Boltzmann distribution. Neither one is adequate for the secondaries of the $\bar{p}p$ annihilation experiments of Argonne and CERN. A thermodynamical model based on the Bose distribution satisfying the "scaling" law is discussed. (auth)

26679 NEW MODEL FOR Z*'S. Dean, Nathan W. (Iowa State Univ., Ames). Particles Nucl.; 1: No. 8, 498-506(May 1971).

The ideas of duality diagrams are formulated in a more quantitative way in order to see where they might fail in accounting for exotic resonances. Positive-strangeness baryons are pictured as reflections of an enhancement in the effective quark-quark interaction. The model predicts that the resulting structure appears simultaneously in different isospin channels of both exotic and nonexotic states. All three Z*'s are in good agreement with the prediction. It is suggested that a selection rule suppressing resonance formation by produced particles will account for the lack of exotic production without forbidding nonexotic resonance production. The Z*'s then become the only exotics accessible to present-day experiments. (auth)

26680 SHAPES OF REGGE TRAJECTORIES. Lam, Kuichuen; Moravcsik, Michael J.; Yu, Wing-yin (Univ. of Oregon, Eugene). Particles Nucl.; 2: No. 1, 1-20(Jul 1971).

Experimental data on baryon masses and intrinsic quantum numbers are tested as to the information they yield about the shapes of Regge trajectories. It is found that evidence, although still scarce, indicates that straight lines in the spin vs. mass-squared plots give a quantitatively good description. It is also found, however, that the suggestions of having parallel trajectories for a given isospin, and of the MacDowell symmetry being exhibited by the trajectories, have no quantitative support in the data. (auth)

26681 BRANCHING RATIOS FOR $\pi^-p \to \eta n$ AND $\pi^-p \to K\Lambda$ FROM A DIRECT-CHANNEL MODEL. Deans, S. R. (Univ. of South Florida, Tampa); Rush, J. E. Particles Nucl.; 2: No. 6, 349-57(Dec 1971).

The data below 2 GeV c.m. energy for the two reactions $\pi^-p \to \eta n$ and $\pi^-p \to K\Lambda$ are analyzed by use of a model which contains only direct-channel one-particle states. A method of damping the resonance terms is utilized and compared with the undamped results. The resulting coupling parameters are used to calculate octet-state mixing angles and admixture parameters for SU(3) symmetry. (auth)

26682 POSSIBLE FORWARD PION–NUCLEON CHARGE EXCHANGE DIP MECHANISM. Dorfman, R. S. (Hartwick Coll., Oneonta, N. Y.). Particles Nucl.; 3: No. 2, 79-91(Feb 1972).

A previous high energy pion–nucleon charge exchange model is discussed. It employs the Chou–Yang Model and Regge theory (ρ exchange). It is proved that no relative maxima, minima, or zeros exist (excluding forward peak) in plots of differential cross sections vs momentum transfer squared for various energies (residue function one, many factors absorbed). A dip obtained by introducing a residue function containing a zero is described. It is suggested to be an interference dip. It is hence stable with energy at considered energies due to the zero and should move with energy at higher energies due to shrinkage if it still exists. The stability with energy is to be compared with considerable movement of "virtual" interference dips when no residue function zero existed. A plot of scattering amplitude phase vs momentum transfer squared is exhibited having structure corresponding to the dip. The dip is seen to correspond to a smaller momentum transfer squared than the original zero, agreeing with interference. This mechanism discourages equating the ρ trajectory zero with the pion–nucleon charge exchange dip. (auth)

26683 PHENOMENOLOGICAL STUDY OF THE AMPLITUDE FOR $K^+n \to K^0p$ REACTION. Matsumoto, Y.; Minami, S. (Osaka City Univ.). Lett. Nuovo Cim.; 3: No. 14, 590-2(1 Apr 1971).

The region of interaction responsible for the $K^+n \to K^0p$ interaction in the forward direction is examined in order to study the nonresonant background irrelevant to the pomeron term. By using the impact parameter representation, it is shown that the forward amplitude for the reaction is dominated by the $l \sim kR$ partial waves, where R ($\simeq 10^{-13}$ cm) is the radius of interaction. (L.B.S.)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 26777 and 27093.

26684 (INP–752) FINITE ENERGY SUM RULES FOR INCLUSIVE PROCESSES. Kwiecinski, J. (Institute of Nuclear Physics, Krakow (Poland)). 1971. 19p. Dep. NTIS (U. S. Sales Only).

Finite energy sum rules for inclusive processes are derived which relate the low missing mass with the triple Regge-pole part of the inclusive cross sections. Emphasis is laid on the necessity of including the appropriate left hand cut contributions in the sum rules. The FESR are illustrated on the example of the process $pp \to pX$ and the smallness of the triple pomeron coupling is confirmed. (auth)

26685 (INR–1351) SEPARABLE MODEL FOR HYPERON NUCLEON INTERACTION. Wycech, Slawomir (Institute of Nuclear Research, Warsaw (Poland)). 1971. 15p. Dep. NTIS (U. S. Sales Only).

A separable, two-channel, potential model is used to describe hyperon nucleon reactions. The parameters of the potential are set to reproduce the low-energy sigma/lambda/nucleon scattering, hypernuclear data and the virtual bound state of the sigma and nucleon. (auth)

26686 (JINR–P2-6251) COHERENT Ω^- AND Ξ HYPERON PRODUCTION ON NUCLEI AND THEIR SPIN AND PARITY DETERMINATION. Kopeliovich, B. Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). Feb 1972. 24p. (In Russian). Dep. NTIS (U.S. Sales Only).

A method for Ω^- parity and spin determination is proposed. If for spin measurement one needs only a sufficient number of events with Ω^- decay, then the determination of Ω^- parity is a problem because Ω^- is always created in the three-particle reactions. These difficulties are absent for the process of meson coherent dissociation on the nucleus into the hyperon-antihyperon pair. Terms in the amplitude, arising from nonzero transverse momentum as well as nuclear spin effects can be neglected. So a large number of events can be exploited. Such reactions can have sizable cross section at high energies if vacuum exchange is allowed. Experimental cross section for the reaction $\bar{k} + z \to \Lambda^0 + \bar{p} + Z$ at a kaon momentum of 12.7 GeV/c, extrapolated to high energies by means of a given formula reaches a value of about 100 μ b. Calculations of polarization effects are made for reaction $\bar{k} + z \to \Omega^- + \Xi^- + Z$, graphically represented. The correlations, sensitive to Ω parity, are written out. Relations between the coefficients depending on Ω^- parity, are represented. All correlations above yield some complementary information about Ω^- parity. The parity of Ξ hyperon can be measured in the same way from the reaction $\bar{k} + z \to \bar{\Xi} + \Lambda^0(\bar{\Sigma}) + z$. (auth)

26687 (N–72-13630) NUCLEAR ELECTROMAGNETIC CASCADES FROM ALPHA PARTICLES INCIDENT ON AN IRON ABSORBER. Jones, W. V. (Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy). [1971]. Contract NAS9-10986. 6p. (NASA-CR-124698; OG-56). NTIS.

Mean values and fluctuations of the nuclear-electromagnetic cascade development resulting from alpha particles incident on an iron absorber was determined for the primary energy range 10 to 300 GeV/nucleon. This was accomplished by using a three-dimensional Monte Carlo simulation of the cascade process. The model used was first adjusted until it gave predictions for a small ionization spectrometer which agreed with measurements obtained by exposing the same spectrometer to 10, 20.5, and 28 GeV/c protons at an accelerator. The calculations were then modified to apply to high energy alpha particles. The results show that measurements of the energies of alpha particles incident on an iron spectrometer with six interaction lengths total depth can be made with accuracies ranging from approximately 5% at 300 GeV/nucleon to approximately 16% at 10 GeV/nucleon. (auth) (STAR)

26688 MULTIPLE QUARK SCATTERING ANALYSIS OF PROTON–PROTON SCATTERING. Thacker, William Carlisle. Urbana, Ill.; University of Illinois (1971). 152p. University Microfilms Order No. 72-7086.

Thesis.

Proton–proton scattering is investigated in a model in which the protons are composed of quarks and the scattering is due to multiple collisions of the quarks. By including spin in the calculation it was hoped that the differential cross section data could be described without resorting to quark amplitudes with t-dependent phases to remove dips which appear in the calculations. The conclusion is that the dips persist even when spin effects are included. (Diss. Abstr. Int., B)

26689 NUCLEON–NUCLEON ELASTIC SCATTERING, USING VENEZIANO FUNCTIONS. Stowe, Keith Stephen. San Diego, Calif.; Univ. of California (1971). 109p. University Microfilms Order No. 72-6462.

Thesis.

A one-boson exchange model for nucleon–nucleon elastic scattering is presented in which the amplitudes are constructed from Veneziano functions. The improvements over traditional OBE models are that all the higher lying meson exchanges are included, and that the amplitudes have the correct asymptotic behavior, allowing the dispersion integrals to be done without the imposition of artificial cutoffs. Hence, the same dynamics responsible for the higher partial waves also give the S-waves, and the number of free parameters in the low energy fits is only three. The problems of many-particle exchange singularities, and the singularity contributions of the inelastic channels are still present, however. The inclusion of a pion conspirator trajectory in these functions enables the same amplitudes to be used to describe the high energy charge exchange scattering in both pn and $p\bar{p}$ channels. (Diss. Abstr. Int., B)

26690 NUCLEON EXCHANGE MECHANISM IN THE INCLUSIVE REACTION $p + p \rightarrow \pi^+$. Roberts, R. G.; Roy, D. P. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Lett.; 38B: No. 7, 507-9(3 Apr 1972).

The nucleon trajectory exchange is shown to describe the inclusive reaction $p + p \rightarrow \pi^+ +$ anything rather well in the positive t region, where the experimental cross section is greatest. In particular, a Chew–Low extrapolation of the triple-Regge expression to the nearby nucleon pole is consistent with the observed pp total cross section. (auth)

26691 PION EXCHANGE AND INCLUSIVE SPECTRA. Bishari, M. (Univ. of California, Berkeley). Phys. Lett.; 38B: No. 7, 510-14(3 Apr 1972).

The implications of pion exchange for inclusive distributions in high energy pp collisions are discussed. An approximate spectrum for $p + p \rightarrow n + X$ is predicted and the possible corrections are pointed out. The role played by π-exchange, in building the asymptotic σ_T(pp), is studied. Other related processes, for which the same analysis applies, are briefly mentioned. (auth)

26692 MAGNETIC MONOPOLE PRODUCTION BY VIRTUAL PHOTONS. Newmeyer, J. L.; Trefil, J. S. (Univ. of Virginia, Charlottesville). Phys. Lett.; 38B: No. 7, 524-6(3 Apr 1972).

The magnetic monopole pair production cross section is estimated from internal virtual photons in p-p collisions. Comparing predictions to the only accelerator experiment to date gives a lower mass limit $M \gtrsim 5$ GeV for monopoles produced by this mechanism. Comparison to the lunar data is made, and provided one accepts several assumptions, a limit of $M \gtrsim 100$ GeV is obtained. The inclusion of final state interactions between monopole and antimonopole is found not to modify the salient features of the other results. (auth)

26693 INVESTIGATION OF THE SECONDARY PARTICLES DISTRIBUTION IN THE HIGH ENERGY HADRON COLLISIONS IN THE STRAIGHT-LINE PATH APPROXIMATION. Barbashov, B. M.; Kuleshov, S. P.; Matveev, V. A.; Pervushin, V. N.; Sisakyan, A. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 10: No. 1, 11-18(Jan 1972). (In Russian).

The problem of multiple production of "soft" mesons in high-energy two-nucleon collisions is considered in the framework of standard quantum field theory models. The straight-line path approximation is used to obtain the Poisson distribution for the number of secondary particles and to investigate the dependence of the average multiplicity on the restrictions on momenta of secondary particles. (auth)

26694 CONNECTION OF THE DEUTERON FORM FACTORS WITH THE PHYSICAL S-MATRIX. Kozhevnikov, V. P.; Troitskii, V. E.; Trubnikov, S. V.; Shirokov, Yu. M. (Moscow State Univ. Mathematics Inst., Moscow). Teor. Mat. Fiz.; 10: No. 1, 47-57 (Jan 1972). (In Russian).

The relativistic parametrization of the matrix element of the electromagnetic current of the neutron-proton system is derived. Nucleon spin and interaction between s- and d-waves of the relative proton-neutron motion as well as the relativistic spin rotation are taken into account. For the free motion the form factors of the system were expressed in terms of the one-particle form factors. As the result of the contribution of the relativistic spin rotation the charge form factor of the n-p system contains the magnetic form factors of the proton and neutron. The results obtained form the necessary basis for the relativistic calculation of the electromagnetic form factors of the deuteron via the physical phases of the n-p scattering. (auth)

26695 ISOSPIN ANALYSIS OF SINGLE PION PRODUCTION IN pp AND pn COLLISIONS AT 7.0 GeV/c. Yekutieli, G.; Yaffe, D.; Shapira, A. (and others) (Weizmann Inst. of Science, Rehovot, Israel). Nucl. Phys.; B38: No. 2, 605-13(1972).

Combined data on the reactions $pp \rightarrow pp\pi^0$, $pp \rightarrow pn\pi^+$ and $pn \rightarrow pp\pi^-$ at 7.0 GeV/c is used to study the peripheral reaction $N_1N_2 \rightarrow N_3(N_4\pi)$ in terms of the isospin amplitudes M^{I_x} (where I_x and I are the isospins of the exchange particle and the $(N_4\pi)$ combination respectively). The total and differential cross sections and the mass distributions $M(N_4\pi)$ of these isospin states are discussed in terms of different possible solutions. Similar analysis at 28.5 GeV/c shows that the $M^0_\frac{1}{2}$ cross section decreases slowly with incident momentum in agreement with pomeron exchange. (auth)

Particle Invariance Principles and Symmetries

Refer also to abstracts 27103 and 27104.

General

Refer also to abstracts 26737, 26738, and 26754.

26696 CRITICAL REMARKS ON THE ASYMPTOTIC SYMMETRY SCHEME. Danskin, J. H. (Harvard Univ., Cambridge, Mass.). Phys. Rev., D; 5: No. 4, 916-22(15 Feb 1972).

The asymptotic symmetry scheme proposed by Oneda and Matsuda is analyzed rather critically on two counts. First of all, the underlying reasons given for the scheme's basic assumption, that single-particle matrix elements of the SU(3) raising operator V^K are effectively not renormalized, even when the symmetry is broken, and it is found that some of the arguments are not completely convincing. Second, it is shown that most of the results of the scheme can be obtained without using this basic assumption, and that it is only most of the results derived from equal-time commutators of the form $[\dot{V}^K, A^i] = 0$ which are necessary consequences of this assumption. These latter results include all of their intermultiplet mass sum rules together with a few other predictions such as the degeneracy of the Σ^0 and Λ^0, and, in general, these are not as well satisfied experimentally as the other results. (auth)

26697 ZERO-MASS DIVERGENCES IN EXPANSIONS ABOUT CHIRAL AND SCALE SYMMETRY. McKay, Douglas W. (Univ. of Kansas, Lawrence); Palmer, William F. Phys. Rev., D; 5: No. 4, 858-64(15 Feb 1972).

Singularities of expansions in the symmetry-breaking parameters of chiral- and scale-asymmetric theories are studied, in the tree approximation, in polynomial Lagrangian models. The singularities are related to the appearance of zero-mass scalar fields, not necessarily Goldstone particles, at the radius of convergence of the expansion. Methods of avoiding these singularities are presented. (auth)

26698 WRITING HAMILTONIANS IN TERMS OF LOCAL CURRENTS. Dicke, Arnold A. (Boston Univ.); Goldin, Gerald A. Phys. Rev., D; 5: No. 4, 845-51(15 Feb 1972).

Several relativistic models are presented which are based on local currents and combine nontrivial internal-symmetry groups with q-number Schwinger terms. Each model is given by specifying a Lie algebra of equal-time current commutators together with a consistent expression for the Hamiltonian as a function of the currents. (auth)

26699 SOME REMARKS ON SYMMETRY GROUPS. Kuo, T. K. (Purdue Univ., Lafayette, Ind.). Phys. Rev., D; 5: No. 4, 1033-8(15 Feb 1972).

A number of general remarks are given in connection with earlier discussions of the outer automorphisms of internal-symmetry groups. (auth)

26700 II LETNYAYA SHKOLA PO PROBLEMAM TEORII ELEMENTARNYKH CHASTITS, OTEPYA, AVGUST 1967. IV CHAST'. PREDEL'NYE (SZHATYE) GRUPPY LI. (Proceedings of the 1967 Summer School on Elementary Particle Physics Held at Otepaa, August 1–13, 1967. Volume 4. Contractions of Lie Groups). Lykhmus, Ya. Kh. Tartu; Institut Fiziki i Astronomii (1969). 133p.

A survey is given of the contemporary state of the theory of limiting transitions in the Lie manifold algebra. The mathematical problems—the general determination of a limiting transformation, the examination of partial types, examples, essential

and adequate conditions for accomplishing limiting transformations, and the problem of classification of limiting transformations are discussed. Basic theories of deformations of algebraic structure are elucidated. The application of the mathematical theory to theoretical physics is discussed, i.e., the theory of elementary particles, the contraction of space–time groups, and the formulation of interaction by agents of the contractions and deformation of limiting transformation in the theory of dynamic systems. (141 references) (tr-auth)

26701 CP VIOLATION OUTSIDE THE $K^0-\overline{K}^0$ SYSTEM. Iliopoulos, J. (Harvard Univ., Cambridge, Mass.). J. Phys. (Paris), Colloq.; No. 3, 67-70(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

A review of the existing experimental evidence for CP conservation outside the $K^0-\overline{K}^0$ system is presented, together with some theoretical speculations. (France)

26702 SOME MACROSCOPIC EFFECTS OF THE GEOMETRIC SCHEME OF VIOLATION OF CP-INVARIANCE. Arbuzov, B. A. (Inst. of High Energy Physics, Serpukhov, USSR). Zh. Eksp. Teor. Fiz.; 62: No. 2, 444-53(Feb 1972). (In Russian).

A hypothesis is proposed according to which the observed time irreversibility (and violation of CP-invariance) is also related to noninvariance with respect to time shifts, a consequence being nonconservation of energy. This assumption may be realized in a scheme with geometrization of the electromagnetic field previously suggested for explaining violation of CP-invariance. Some consequences are considered and it is shown that for values of the fundamental parameter $l_0 \approx 10^{-17}$ cm the scheme is not inconsistent. (auth)

26703 DECOMPOSITION OF THE POSITIVE MASS AND ZERO SPIN REPRESENTATION OF THE POINCARE GROUP USING THE LORENTZ SUBGROUP. Angelopoulos, E. (Univ., Paris). Ann. Inst. Henri Poincare, Sect. A; 15: No. 4, 303-20 (Nov-Dec 1971). (In French).

The reduction of the irreducible unitary representation (M,0) of the Poincare group is sketched by harmonic analysis using the Lorentz group. The irreducible components are identified using its Lie algebra and representations of this algebra. The introduction of a suitable nuclear space associated with the initial representation gives meaning to a formal algebraic decomposition, and facilitates a preliminary selection of the components obtained. These components are the eigenvectors of an essentially autoadjoint operator. When only the real part of the spectrum is considered, the final result (the principal zero spin Lorentz sum) is obtained. Analogies with similar decomposition problems are made: the topological conditions imposed are examined. (France)

26704 GENERALIZED O(2,1) EXPANSIONS FOR ASYMPTOTICALLY GROWING AMPLITUDES. II. SPACE–TIME REGION. Jones, C. E.; Low, F. E.; Young, J. E. (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.); 70: No. 1, 286-97(Mar 1972).

A previous treatment (Jones, et al., Ann. Phys., New York, 63 (1971), 476) of O(2,1) expansions for nonsquare-integrable many particle amplitudes is extended to the case where one "incoming" and one "outgoing" cluster have space-like O(2,1) momenta. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 26492, 26563, and 26892.

26705 (NYO–3829-84) TWO-VARIABLE EXPANSIONS AND THE $K \to 3\pi$ DECAYS. Hicks, H. R. (Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Physics); Winternitz, P. (Pittsburgh Univ., Pa. Dept. of Physics). Dec 1971. Contract AT(30-1)-3829. 39p. Dep. NTIS.

Previously suggested two-variable expansions of three-body decay amplitudes in terms of harmonic functions of an O(4) group are discussed and applied to analyze the Dalitz plot distribution of over 3.2 million $K^+ \to \pi^+\pi^+\pi^-$ decay events. Amongst the general features of the O(4) expansions it is stressed that they are written in the c.m.s. of two of the final particles, the angular momentum of which is displayed explicitly and that each term in the expansion has a good behavior at the threshold, pseudo-threshold, and at the boundary of the physical region. The recent data of Ford et al. on charged $K \to 3\pi$ decays are analyzed using both the O(4) expansion and the standard power series expansion in terms of the Dalitz–Fabri variables. In both cases it is perfectly adequate to keep four terms in the corresponding expansion. The χ^2-fit is marginally better for the O(4) expansion. It is concluded that the $K \to 3\pi$ Dalitz plot has too little structure in it to provide a real test of the advantages or disadvantages of different treatments. It is thus most desirable to apply the O(4) expansions to Dalitz plots of other processes, like $\eta \to 3\pi$ or $\bar{p}n \to \pi\pi\pi$. No conclusive evidence is found for CP violation. However, the "linear" term in the O(4) expansion of the difference between the squared matrix elements for K^+ and K^- decays does differ from zero by more than two standard deviations. The effect is stable with regard to the number of terms kept in the expansions. An important distinctive feature of the O(4) expansions is their intimate relation to two-variable O(3,1) expansions of physical scattering amplitudes. (auth)

26706 MASS FORMULAS BASED ON SL(3,C). Kurosawa, Kazutoshi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1837-48(Dec 1971).

Mass formulas similar to Okubo-Gell-Mann's but in a more restricted form are obtained based on SL(3, C). Some of the calculations based on the SU(3) symmetry can be considered from the viewpoint of SL(3, C), and relations between the different SU(3)-multiplets can be obtained using the Casimir invariants of SL(3, C). As examples, the mass formulas and electromagnetic mass splittings of hadrons are presented. (auth)

26707 REMARKS ON THE ALGEBRA OF CURRENTS IN THE PRESENCE OF ELECTROMAGNETISM. Riazuddin (Univ. of Maryland, College Park); Fayyazuddin. Ann. Phys. (N. Y.); 69: No. 2, 487-93(Feb 1972).

It is shown that in order to avoid a contradiction, either the equal-time commutation relations of charged vector or axial vector currents should be modified by a term of order e in the presence of electromagnetism if $V_{3\lambda}$ which enters on the right side of these commutation relations is to be regarded as the source of the isovector part of the electromagnetic potential or, if these equal-time commutation relations are exact and valid in the usual form in the presence of electromagnetism, $V_{3\lambda}$ is not the source of the isovector part of the electromagnetic potential but differs from the latter by a term of order e. (auth)

26708 FORM FACTORS IN K_{l3} DECAY. Kluberg, L. (Ecole Polytechnique, Paris). J. Phys. (Paris), Colloq.; No. 3, 53-7 (1971). (In French).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

The energy dependence of the K meson form factor f^+ is characterized by λ^+ when a linear variation is assumed. The different experimental determinations are reviewed. (France)

26709 CP VIOLATION IN NEUTRAL KAON DECAYS. Repellin, J. P. (Ecole Normale Superieure, Orsay, France. European Organization for Nuclear Research, Geneva). J. Phys. (Paris), Colloq.; No. 3, 59-66(1971).

From Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971).

The violation of CP in the decay of the neutral K system is presented after a survey of the experimental results, the methods used, and the expected results of envisaged experiments. (France)

Applications (Strong)

Refer also to abstracts 26617 and 27095.

26710 SPECIAL BOOTSTRAPPING PROPERTY OF SU(n) LIE ALGEBRAS. Capps, Richard H. (Purdue Univ., Lafayette, Ind.). Phys. Rev., D; 5: No. 4, 1018-20(15 Feb 1972).

It is shown that certain simple bootstrap conditions, applied to a hypothetical universe of mutually interacting mesons, require SU(n) symmetry of the interactions. The relevant distinguishing feature of SU(n) is that the matrices of the fundamental representation of the Lie algebra, together with the identity matrix, are a complete set. (auth)

26711 MINIMAL INTERACTION OF π-MESONS. Volkov, D. V.; Zheltukhin, A. A.; Tkach, V. I. (Physical-Technical Inst., Kazan). Teor. Mat. Fiz.; 10: No. 3, 329-37(Mar 1972). (In Russian).

Introducing of the minimal interaction principle is considered in the cases of the π-mesons interacting with elementary or composite nucleons. The method of phenomenological SU(2) ⊗ SU(2) chiral invariant Lagrangians is used. It is shown that by using the geometrical approach in the phenomenological Lagrangian method makes it possible not to restrict oneself by the purely group-theoretical approach and leads to additional conditions on phenomenological constants. The connection with higher symmetries in the considered approach is revealed in the algebraic realization of

chiral symmetry for the axial—vector coupling matrices $X_a(\lambda)$ obtained by Weinberg. (auth)

Field Theories

General

Refer also to abstract 26550.

26712 CLASS OF EXACT SOLUTIONS FOR COUPLED ELECTROMAGNETIC AND SCALAR FIELDS FOR EINSTEIN–ROSEN METRIC. I. Rao, J. R.; Roy, A. R.; Tiwari, R. N. (Indian Inst. of Tech., Kharagpur). Ann. Phys. (N. Y.); 69: No. 2, 473-86 (Feb 1972).

A class of rigorous solutions for the Einstein–Rosen nonstatic cylindrically symmetric metric in the presence of combined electromagnetic and scalar meson fields was obtained. Some of these solutions reduce to the solutions obtained by Misra and Radhakrishna [Proc. Nat. Inst. Sci. India Part A 28 (1962), 632] when the scalar field is not present. (auth)

26713 NOETHER'S THEOREM IN CLASSICAL FIELD THEORY. Rosen, Joe (Tel-Aviv Univ., Israel). Ann. Phys. (N. Y.); 69: No. 2, 349-63 (Feb 1972).

Within the lagrangian formalism in classical field theory Noether's theorem is generalized so as to abolish the role of invariance considerations in it. Examples of application of the generalized formulation are presented for comparison with the usual formulation. It is shown that symmetry transformations do not necessarily lead to continuity equations (from which conservation laws are obtained), while transformations associated with continuity equations are not necessarily symmetry transformations. The inverse Noether theorem and families of transformations leading to the same continuity equations are discussed. Possible utility of the generalized formulation even when there is no lagrangian density is suggested. (auth)

26714 FLUCTUATION ELECTROMAGNETIC FIELD OF THE UNIVERSE: STOCHASTIC ELECTRODYNAMICS. Surdin, M. (Univ., Bordeaux). Ann. Inst. Henri Poincare, Sect. A; 15: No. 3, 203-41 (Oct-Nov 1971). (In French).

A stochastic electrodynamics based on the concept of the random electromagnetic field of the universe is developed. The Schrödinger equation is obtained using strictly classical deterministic arguments. The derivation of Schrödinger equations forms the link between vacuum stochastic electrodynamics and quantum mechanics. An electromagnetic model of gravitation is advanced and a simple mathematical formalism is derived. This formalism is used to solve various problems, such as: the magnetic field of rotating bodies, the emission of gravitational waves by a body in motion, and the cosmic background noise. (France)

Quantum Field Theory

Refer also to abstracts 26398–26400, 26405, 26470, 26481, 26532, and 26552.

26715 (JINR–P2-6342) ON AUTOMODEL ASYMPTOTICS IN QUANTUM FIELD THEORY. I. Bogolyubov, N. N.; Vladimirov, V. S.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 30p. (In Russian). Dep. NTIS (U. S. Sales Only).

A technique is developed which allows one to study the asymptotic properties of the Fourier transform of the current commutator between the identical one-particle states in the framework of axiomatic quantum field theory. It is shown that in the case of the deep-inelastic electron scattering by nucleons under some assumptions the property of asymptotic automodelity takes place. (auth)

26716 (NP–19232) NONLINEAR LEE MODEL. Note No. 340. Calogero, F. (Rome Univ. (Italy). Istituto di Fisica, Istituto Nazionale die Fisica Nucleare, Rome (Italy)). 17 Nov 1971. 11p. Dep. NTIS (U. S. Sales Only).

The model characterized by the Hamiltonian $H = H_0 + f(H_I)$, where f(x) is a largely arbitrary (real) function and H_0 resp. H_I are the free resp. interaction part of the Hamiltonian of the usual Lee model, is solved exactly (in one sector of its Hilbert space). The solutions resemble, but are somewhat richer than, the corresponding solutions of the usual Lee model. (auth)

26717 (NYO–3829-86) PERTURBATION LAGRANGIAN THEORY FOR SCALAR FIELDS: WARD–TAKAHASHI IDENTITY AND CURRENT ALGEBRA. Lam, Yuk-Ming P. (Pittsburgh Univ., Pa. Dept. of Physics). Jan 1972. Contract AT(30-1)-3829. 49p. Dep. NTIS.

Under the assumption that the time-ordered products are given by Feynman rules with Bogoliubov's renormalization scheme, it is shown that the operator forms of Euler–Lagrange equations of motion and Noether's theorem for a wide class of perturbation Lagrangian theories for scalar fields are valid. Ward–Takahashi identities for currents in Noether's theorem are also proved without recourse to equal-time commutators, and current-algebra results follow naturally in a subclass of Lagrangian field theories. Covariant Schwinger terms are present in these identities, and their nature is determined. (auth)

26718 (NYO–3829-88) GAUGE INVARIANCE AND WARD IDENTITIES IN A MASSIVE VECTOR MESON MODEL. Lowenstein, J. H. (Pittsburgh Univ., Pa. Dept. of Physics); Schroer, B. (Freie Universitaet, Berlin (West Germany). Institut fuer Theoretische Physik). Feb 1972. Contract AT(30-1)-3829. 54p. Dep. NTIS.

Normal product techniques are applied to the study of gauge invariance in a massive vector meson model in renormalized perturbation theory. Composite fields are defined which are invariant under a one-parametric family of covariant gauge transformations. Ward identities are derived for Green's functions involving an arbitrary number of vector and axial-vector currents. The lack of lowest-order radiative corrections to the triangle anomaly of the axial-vector Ward identity is verified using BPHZ methods. (auth)

26719 PHASE-SPACE DESCRIPTION OF QUANTUM MECHANICS. Ruggeri, G. J. (Univ. Central de Venezuela, Caracas). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1703-12 (Dec 1971).

Phase-space distribution functions for a non-relativistic quantum particle are defined as the mean value of certain operators, whose most general forms are determined by the requirements of Galilean, parity and time-reversal invariances. The rule of associating phase-space functions to quantum mechanical operators, induced by the general distribution function, is considered. The resulting scheme unifies previous work on this subject. (auth)

26720 HIGHER-ORDER CORRECTIONS IN NONRENORMALIZABLE QUANTUM FIELD THEORIES. Nitti, L.; Pellicoro, M. F.; Villani, M. (Univ., Bari, Italy. Istituto Nazionale di Fisica Nucleare, Bari, Italy). Lett. Nuovo Cim.; 3: No. 13, 541-7 (25 Mar 1972).

A general summation procedure is proposed for perturbative series with divergent terms, arising from nonrenormalizable Lagrangians. The method is applied to Feynman graphs for the process $\mu^- + \nu_e \rightarrow \nu_\mu + e^-$. (L.B.S.)

26721 EQUIVALENCE BETWEEN TWO FORMULATIONS OF CONFORMAL COVARIANT OPERATOR PRODUCT EXPANSIONS. Bonora, L. (Univ., Padua. Istituto Nazionale di Fisica Nucleare, Padua). Lett. Nuovo Cim.; 3: No. 13, 548-50 (25 Mar 1972).

It is shown that the conformal covariant operator product expansions for two spinless fields formulated by Bonoro, Sartori and Tonin (1 FPTH-6/71) and by Ferrara, Gatto, and Grillo (Lett. Nuovo Cimento) are equivalent. (L.B.S.)

26722 EXPLICIT SOLUTIONS OF A NONLINEAR EQUATION FOR THE QUANTUM SCALAR FIELD. Raczka, R. (Univ. of Colorado, Boulder). Lett. Nuovo Cim.; 3: No. 13, 575-7 (25 Mar 1972).

Explicit solutions are obtained for the dynamical equation for a quantum scalar field in the Fock space spanned by the creation and annihilation operators of free particles with mass m, using the method of orthogonal expansion of unbounded operators. (L.B.S.)

26723 RELATIVISTIC PARTICLES IN EXTERNAL FIELDS. Ekstein, H. (Argonne National Lab., Ill.). Phys. Rev., D; 5: No. 4, 864-71 (15 Feb 1972).

Axiomatic field theories suffer from a lack of nontrivial examples and especially of realistic ones. An enlarged system of basic assumptions that encompasses the case of external fields is explored. Then the Dirac theory of the hydrogen atom, for example, becomes both an example and a clue for further postulates. For nonrelativistic (Galilean) physics, a set of assumptions called presymmetry was found to account for the general features of empirically verified theories. Those assumptions of presymmetry that seem reasonably extendable to the case of a Poincaré-covariant algebra of observation procedures are found to agree with properties of the theory of an electron-positron field in an external electromagnetic field. The full structure of the algebra of observation procedures remains to be explored, with the hope of finding additional structure in theories of interacting

fields. Another motivation of more immediate interest is the desire for a general set of constraints in describing systems, typified by the hydrogen atom, in which one part of the system is sufficiently heavy to be idealized as a source of an external field, while the other has relativistic velocities. (auth)

26724 DILATATION AND DIMENSIONAL TRANSFORMATIONS. Aurilia, Antonio (Univ. of Alberta, Edmonton); Takahashi, Yasushi; Umezawa, Hiroomi. Phys. Rev., D; 5: No. 4, 851-8(15 Feb 1972).

The effect of a field redefinition on the dilatation transformation is considered. It is proposed that the generator of the dilatation transformation is modified if the divergence of the dilatation current can be expressed in the form of the divergence of a local current as a consequence of field equations. The notion of the dimensional transformation is introduced to generalize the case when the dilatation current does not satisfy the above condition. The dimensional transformation is worked out in detail in the case of a massive neutral scalar field. (auth)

26725 GAUGE TRANSFORMATION IN THE THIRRING MODEL. Mueller, A. H. (Brookhaven National Lab., Upton, N. Y.); Trueman, T. L.; Wilson, Kenneth G. Phys. Rev., D; 5: No. 4, 1026-7 (15 Feb 1972).

It is shown that gauge transformations, which modify the dimension of the field $\psi(x)$ in the Thirring model, leave invariant the anomalous dimension of the compound fields $\phi_4(x)$. The modifications of the operator-product expansion of $T(\psi(x)\bar{\psi}(y))$ required by the gauge transformation are also presented. (auth)

26726 DERIVATION OF IWASAKI'S PROPAGATORS FROM LAGRANGIANS. Snoke, J. A. (Middle East Technical Univ., Ankara). Phys. Rev., D; 5: No. 4, 1052-5(15 Feb 1972).

Using Schwinger's formulation of the Green's function and the assumption that the covariant propagator is equal to the time-ordered Green's function, Iwasaki's covariant propagators are derived from Lagrangians introduced by Chang. (auth)

26727 RENORMALIZABLE MASSIVE VECTOR-MESON THEORY: PERTURBATION THEORY OF THE HIGGS PHENOMENON. Lee, Benjamin W. (National Accelerator Lab., Batavia, Ill. State Univ. of New York, Stony Brook). Phys. Rev., D; 5: No. 4, 823-35(15 Feb 1972).

It is established that the Abelian gauge theory first considered by Higgs in which the gauge vector boson acquires a finite mass due to the spontaneous breakdown of symmetry is renormalizable, in the sense that the Bogoliubov–Parasiuk–Hepp program can be executed in such a way that the Ward–Takahashi identities are satisfied. The global study of the Ward–Takahashi identities and low-energy theorems of the model are presented. It is shown that the Goldstone boson and the scalar excitation of zero mass associated with the Landau-gauge vector propagator are unphysical, and disappear from the S matrix. (auth)

26728 STRESS-ENERGY VERTEX IN THE THIRRING MODEL. Shapero, Don (Massachusetts Inst. of Tech., Cambridge. IBM Watson Research Center, Yorktown Heights, N. Y.). Phys. Rev., D; 5: No. 4, 1024-5(15 Feb 1972).

It is shown that it is possible to calculate the stress-energy vertex in the Thirring model using the conservation equations obeyed by the stress-energy tensor and the conformal-group transformation properties of the solution of the model. (auth)

26729 NEW DERIVATION OF THE LORENTZ TRANSFORMATION. Landau, B. V.; Sampanthar, S. (Univ. of Salford, Eng.). Amer. J. Phys.; 40: No. 4, 599-602(Apr 1972).

It is shown that Newtonian mechanics plus the assumption that the mass of a particle varies with its velocity according to the formula $m = m_0/(1 - v^2/c^2)^{\frac{1}{2}}$ lead to the Lorentz transformation. (auth)

26730 COMPARISON OF RAYLEIGH–SCHROEDINGER AND BRILLOUIN–WIGNER PERTURBATION THEORIES. Silvert, William (Univ. of Kansas, Lawrence). Amer. J. Phys.; 40: No. 4, 557-61(Apr 1972).

Parallel derivations of Rayleigh–Schrödinger and Brillouin–Wigner perturbation theory are presented, using the Dirac formalism. The relative advantages and disadvantages of the two are compared with the goal of smoothing the transition between elementary quantum mechanics and advanced approximation theory. (auth)

26731 YANG–MILLS' FIELD AND ITS APPLICATIONS. Chen, Shou-fong. Stony Brook, N. Y.; State Univ. of New York (1971). 87p. University Microfilms Order No. 72-6385.

Thesis.

An attempt is made to understand some aspects of the Yang–Mills' type gauge field. It is proved that the algebra of the gauge field is the same either with or without anomalous moment type coupling. Then Miyazaki's representation of the current is used to calculate the electromagnetic form factors of the hadrons. First the energy–momentum conservation laws of the Yang–Mills' field are proven. Then it is shown that the equations of motion of a classical isotopic-spin-carrying particle are a consequence of the Yang–Mills' field equation, similar to the case in general relativity. A static solution of the Yang–Mills' field equation with δ-function sources is found. Using this solution, one can derive the force between the source particle and the test particle. The motion of the test particle, which involves solving two coupled equations, is explicitly evaluated. The attempt to solve the time dependent nonlinear free Yang–Mills' field equation encounters as yet unexplanable singularity. The scale invariance principle is explored. An attempt to construct a gauge-like field for the scale invariant theory is unsuccessful. However, from general relativity, which is a scale invariant theory, it is proved that the trace of the energy momentum tensor must vanish. (Diss. Abstr. Int., B)

26732 UNIQUENESS OF INTERACTIONS INVOLVING HIGHER SPIN PARTICLES. Etemadi, Babak. Tallahassee; Florida State Univ. (1971). 98p. University Microfilms Order No. 72-9201.

Thesis.

The free-field Lagrangian, as well as the propagators for particles of spin greater than one, contain one or more arbitrary parameters. However, the S-matrix elements for the interaction of a high-spin field with other fields ought to be always independent of these parameters, provided the interaction Lagrangian is properly chosen. To select the proper interaction Lagrangian, the invariance of the interaction Lagrangian under a certain set of point transformations should be utilized, and at every step the consistency with the principles of second quantization should be confirmed. This consistency can be realized either by quantizing the interacting fields on space-like surfaces or by using generalized Matthew's rule. This approach is applied to a system of a spin $^3/_2$-field coupled to a nucleon and a pion field. The coupling of a spin-2 field to two pion fields is considered also. The uniqueness of S-matrix elements for these cases is shown explicitly. Using this model for the evaluation of the $\Delta(1238)$ and $f_0(1260)$ contributions and the usual chiral invariant Lagrangian for the nucleon pole and rho pole contributions, the πN and $\pi\pi$ scattering lengths were computed and compared with the experimental data. (Diss. Abstr. Int., B)

26733 NEW DEVELOPMENTS IN THE THEORY AND COMPUTATION OF THE LAMB SHIFT. Fox, John Adams. Ithaca, N. Y.; Cornell Univ. (1971). 123p. University Microfilms Order No. 72-8851.

Thesis.

An investigation is made of three aspects of bound-state quantum electrodynamics. The reformulation of renormalization theory by Kuo and Yennie is extended to include bound states, and using the results, a simple derivation of the theoretical expression for the displacement of atomic energy levels is presented. A discussion is given of the problem of infrared divergences in bound state analysis, and a new method for demonstrating the cancellation of infrared factors is briefly presented. Various computational methods are described, and a description is given of a computer assisted calculation of one contribution (the crossed graph) to the fourth-order Lamb shift. (Diss. Abstr. Int., B)

26734 INTRODUCTION OF QUARK MASS IN A CHIRAL GAUGE-INVARIANT LAGRANGIAN. Bose, Subir Kumar (Univ. of Manchester, Eng.). Particles Nucl.; 2: No. 3, 173-7(Sep 1971).

The problem of writing a quark mass term in a chiral gauge-invariant Lagrangian is considered. The first method uses the technique of Weinberg and Schwinger. If the symmetry-breaking in this method is used according to Minamikawa's way and the results are compared with corresponding to the one obtained by using Gell-Mann, Oakes and Renner Hamiltonian, it is found that, in principle, the quark masses could be determined in terms of some physical constants. In the second method Nambus' method is adopted. Here the main features are that the scalar mesons are needed in the theory the same way as vector mesons in local gauge theory, and the axial-vector mesons are massive. (auth)

26735 ADIABATIC THEOREM IN QUANTUM FIELD THEORY. Likhachev, V. N.; Tyupkin, Yu. S.; Shvarts, A. S. (Moscow Engineering-Physics Inst.). Teor. Mat. Fiz.; 10: No. 1, 63-84(Jan 1972). (In Russian).

The definition is pointed out of the renormalized S-matrix in quantum field theory, which is based on the limit transition from

the adiabatic S-matrix in finite volume. It is demonstrated that under certain conditions the new definition is equivalent to the usual one. (auth)

26736 PARTIAL TAKING INTO ACCOUNT OF THE SELF-INTERACTION IN THE SIMPLEST MODEL OF THE QUANTUM FIELD THEORY. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 10: No. 1, 58-62 (Jan 1972). (In Russian).

The validity of the additivity relations is demonstrated. The one-particle solution of the Schrödinger equation is used for transforming this equation to a simpler form. The transformation performed corresponds physically to the taking into account and the exclusion of the part of the self-interaction which is responsible for the production of the one-particle state. (auth)

26737 EXPANSION OF A RELATIVISTIC EXCHANGE PROPAGATOR INTO PARTIAL WAVES AND CALCULATION OF A COULOMBIAN INTEGRAL USING THE O(4) AND SL(2,R) GROUPS. Gazeau, J. P. (Univ., Paris). Compt. Rend., Ser. B; 273: No. 25, 1074-7(20 Dec 1971). (In French).

All relativistic exchange propagators after two successive transformations (the Wick rotation and the stereographic projection of Fock) possess an expansion in partial waves with the Y_{nlm} hyperspherical harmonics associated with the O(4) groups, and with hypergeometric functions associated with the SL(2,R) group. The intervention of an irreducible representation of SL(2,R) is established by the use of the body of the quaternions upon which the elements of this locally compact group operate as homographic transformations. SL(2,R) thus leads to a unity between a large number of Coulomb or Yukawa type problems, which may or may not be relativistic. (France)

26738 NEW SYMMETRY GROUP IN RELATIVISTIC QUANTUM MECHANICS. Horchani, Salah (Univ., Dijon, France). Ann. Inst. Henri Poincare, Sect. A; 15: No. 4, 321-49(Nov-Dec 1971). (In French).

A new symmetry group (P_2) is introduced into relativistic quantum mechanics. This group presents the following characteristics: there exists a local and covariant four-vector position operator, within the observables chosen from representants of its Lie algebra (this quadri-operator leads to a proper-time observable, which, like the mass observable is not invariant); components of the energy-momentum vector and components of the 4-vector position operator verify the generalized Heisenberg relations; P_2 is the minimal group having these properties. (France)

26739 DIFFERENTIAL EQUATION APPROACH TO QUANTUM FIELD THEORY. CAUSALITY PROPERTY FOR THE SOLUTIONS OF THIRRING'S MODEL. de Mottoni, P. (Consiglio Nationale delle Richerche, Rome); Sslusti, E. Ann. Inst. Henri Poincare, Sect. A; 15: No. 4, 351-60(Nov-Dec 1971).

A causality property is established for the solutions of Thirring's model, where the fields are operator valued functions of the space time variables. This property is expected for the convolution of a Wightman field with a compactly supported C to the power of infinity function. (France)

26740 MASSIVE GAUGE FIELDS. Slavnov, A. A. (Inst. of Mathematics, Moscow). Teor. Mat. Fiz.; 10: No. 3, 305-28 (Mar 1972). (In Russian).

The principal results of the quantum theory of gauge fields with nonzero rest mass are discussed. The gauge-invariant formulation of the theory, the renormalization problem and the relation to the theory of massless gauge fields are considered. (auth)

26741 CAUCHY PROBLEM FOR DIRAC EQUATION IN THE DE SITTER SPACE AND THE ANTICOMMUTATOR. Shavokhina, N. S. (Kazan State Univ.). Teor. Mat. Fiz.; 10: No. 3, 412-23(Mar 1972). (In Russian).

The Cauchy problem for the Dirac equation in the de Sitter space is solved. Using the solution obtained, an explicit expression for the spinor field anticommutator in the space considered is deduced. (auth)

26742 NON-POLYNOMIAL LEE-LIKE MODEL WITHOUT GHOSTS. Patil, S. H. (Indian Inst. of Tech., Bombay). Nucl. Phys.; B38: No. 2, 614-620(1972).

A Lee-like nonpolynomial Lagrangian is discussed. The fourth order calculations in the major coupling, for the propagator function are finite but dominate over the second order terms, asymptotically. This implies that for using nonpolynomial Lagrangians at high energy, the higher order terms must be included in the major coupling. It is shown that the model has no ghosts, but does not satisfy the theorem of Lehmann, Symanzik and Zimmermann. (auth)

26743 MOMENTUM AND ANGULAR MOMENTUM IN RELATIVISTIC CLASSICAL PARTICLE MECHANICS. Jordan, T. F. (Univ. of Minnesota, Duluth); Shukre, C. S. Phys. Rev., D; 5: No. 4, 799-801(15 Feb 1972).

For a classical-mechanical system of any fixed number of particles it is observed that space-translation invariance and conservation of angular momentum imply conservation of momentum. For three particles it is shown, as previously for two, that Poincaré invariance implies that the total kinematic momentum cannot be a constant of motion unless the accelerations are zero. The equations involved make it appear most likely that this is true for any number of particles. (auth)

26744 FREQUENCY DEPENDENCE OF THE SPEED OF LIGHT IN SPACE. Bay, Z.; White, J. A. (National Bureau of Standards, Washington, D. C.). Phys. Rev., D; 5: No. 4, 796-9(15 Feb 1972).

To characterize the possible dispersion of the velocity of light in space (vacuum) a Cauchy-type formula, $n^2 = 1 + A/\nu^2 + B\nu^2$, is used. It is shown that relativity only allows a nonzero A term, independent of the nature of the waves or a quantization thereof. Recent experimental data provide upper bounds for A and B, limiting thereby the dispersion in the microwave, infrared, visible, and ultraviolet regions of the spectrum to less than one part in 10^{20}. (auth)

26745 JOSEPHSON EFFECT AS A BASIS FOR DETERMINATION OF FUNDAMENTAL CONSTANTS: EXPERIMENT. Langenberg, D. N. (Univ. of Pennsylvania, Philadelphia). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 203-12(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The Josephson effect in systems of weakly coupled superconductors or superfluids has recently assumed considerable importance in the determination of several fundamental physical constants. It already provides the basis for the most accurate determination of e/h and promises to yield values of h/m_e and h/M_{He} of significant accuracy in the near future. The experimental properties of the Josephson effect which are important in such determinations are discussed. Achievements to date are reviewed, and possible future developments are described. (auth)

26746 PULL-IN EFFECT OF JOSEPHSON OSCILLATORS AND AN IMPROVED METHOD OF e/h DETERMINATION. Kose, V.; Fack, H.; Melchert, F.; Schrader, H.-J. (Physikalisch-Technische Bundesanstalt, Brunswick). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 219-22(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Constant voltage steps in dc current-voltage characteristics occur by assuming pull-in phenomena of Josephson oscillators. It is demonstrated that the step amplitude depends on the frequency and the amplitude of the external applied signal. A much more accurate measurement system for e/h determination than those previously published is described. (auth)

26747 MEASUREMENT OF 2e/h BY THE JOSEPHSON EFFECT. Petley, B. W.; Gallop, J. C. (National Physical Lab., Teddington, Eng.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 227-9(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Recent work on the measurement of 2e/h is discussed. Work has continued on the use of the solder-drop type of junction and the d-c measuring techniques were improved, partly by using Hamon resistors. (auth)

26748 PROGRESS TOWARD THE JOSEPHSON VOLTAGE STANDARD: A SUB-PART-PER-MILLION DETERMINATION OF 2e/h. Finnegan, T. F.; Denenstein, A.; Langenberg, D. N. (Univ. of Pennsylvania, Philadelphia). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 231-7(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

An ac Josephson effect determination of 2e/h is described, in which an adjustable (via frequency) Josephson source voltage near 10 mV is compared with a standard cell voltage by means of a fixed 100:1 voltage ratio. Two methods for establishing this ratio were used. One is based on a double series-parallel exchange resistance network, and the other on a double binary resistance chain which is self-calibrated. The ratios obtained with the two methods agree within 0.06 ppM. The precision of the measurements referred to the local voltage standard is better than 0.04 ppM. The accuracy of the measurement referred to the National Bureau of Standards (NBS) as-maintained volt is 0.16 ppM and is presently limited by uncertainties in relating the local

volt to the NBS as-maintained volt. The demonstrated intrinsic precision of better than 0.04 ppM makes practical the ac Josephson effect as a fundamental solid state voltage standard. The techniques developed in the present measurements also provide sufficient stability and resolution to permit unambiguous studies of the factors which presently limit the reliability of conventional electrochemical voltage standards. (auth)

26749 QUANTUM ELECTRODYNAMIC THEORY: ITS RELATION TO PRECISION LOW ENERGY EXPERIMENTS. Brodsky, Stanley J. (Cornell Univ., Ithaca, N. Y. Stanford Univ., Calif.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 297-307(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

At present not even one of the crucial tests of quantum electrodynamics indicates any serious discrepancy. The key to the unraveling of previous conflicts has been the ac Josephson junction e/h determination of the fine structure constant α and new algebraic and numeric techniques for the evaluation of higher order radiative corrections—especially fourth order contributions to the Lamb shift and sixth order contributions to the electron and muon anomalous magnetic moments. In addition, recent measurements of the muon moment and the hyperfine splitting of muonium now permit a test of QED free of hadronic and weak interaction complications at a precision of 5 ppM. (auth)

Gravitation and General Relativity

Refer also to abstracts 26590 and 27128.

26750 (KFKI-71-81) ELECTROVAC FIELDS WITH GEODESIC EIGENRAYS. Lukacs, B.; Perjes, Z. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). [1970]. 15p. Dep. NTIS (U. S. Sales Only).

The stationary states of electrovac fields for which the geodesic eigenrays of both the Maxwell- and the gravitational field coincide are investigated. The fact that the Kerr–Newman solutions belong to this class lends physical interest to the fields considered here. Particular attention is devoted to fields with shearing eigenrays since principal null congruences do not coincide with eigenrays in this case, and so earlier approaches to the problem fail. By the generalization of a theorem on the corresponding vacuum case, it is proven that no "spherical" solutions exist in the shearing class, with the exception of the fields with $\gamma^2 \equiv |G_0|^2 - |H_0|^2 = 0$. The metrics with $\gamma \neq 0$, admitted by the theorem, can either be calculated from the corresponding vacuum solutions by a relatively simple procedure, or, if not, they are listed explicitly. (auth)

26751 (NP-19246) ROTATING REFERENCE SYSTEMS IN EINSTEIN'S THEORY OF GRAVITATION. Note No. 337. Pietronero, L. (Rome Univ. (Italy). Istituto di Fisica). 29 Sep 1971. 10p. Dep. NTIS (U. S. Sales Only).

The role of Coriolis and centrifugal forces in rotating reference systems in Einstein's theory of relativity is studied. (J.F.P.)

26752 SOME PLANE SOLUTIONS OF THE COMBINED EINSTEIN–MAXWELL FIELD EQUATIONS. Cantoni, Vittorio. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 50: No. 2, 156-62(Feb 1971).

A set of simultaneous solutions of Maxwell and Einstein equations are derived which provide an exact description of linearly polarized plane electromagnetic waves and of the associated gravitational field. The form of the solutions allows a weakening of the regularity of the electromagnetic tensor, which can be assumed to be only piecewise C^2 to satisfy the weakest physically admissible regularity conditions. The corresponding solutions can be interpreted as representing gravitational-electromagnetic shock waves. Also sandwich waves are constructed and shown to be able to modify the internal kinetic energy of a cloud of neutral test particles. (J.F.P.)

26753 SUBSTITUTION LAW AND IDENTITY FOR LONG-RANGE POTENTIALS. Hiida, Kichiro; Okamura, Hiroshi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1885-1904(Dec 1971).

The relations between two-body and many-body static potentials for long-range interactions are discussed. There is a simple substitution law to get the two-body potential $V_2^{(2n)}$ in the 2n-th order from (n + 1)-body potential v_{n+1} obtained from tree diagrams for (n + 1)-body scatterings. When interaction Lagrangian density is proportional to mass in the static limit, the identity $V_{n+1} = V_2^{(2n)}$ holds, V_{n+1} being the two-body potential obtained from v_{n+1} by summing it up over all elementary particles in two celestial bodies or charged spheres. These statements are proved to be right for n = 2 and partly for n = 3, and expected to be true for all values of n. The reason why the substitution law exists and the identity holds is discussed in detail. (auth)

26754 SCALE INVARIANCE AND GRAVITY OF HADRONS. Fujii, Ysaunori (Tokyo Univ.). Ann. Phys. (N. Y.); 69: No. 2, 494-521(Feb 1972).

The mixing between the graviton and the dilaton (a Goldstone boson of the scale transformation) is investigated. It is shown that there is no inconsistency in the proposed identification of the nonsense zero point of the f' trajectory with the dilaton. Particularly interesting results follow if the dilaton mass squared is of the order of $G\alpha'^{-2}$, where G is the Newtonian gravity constant while α' is the universal slope of the Regge trajectories. The gravity potential between two hadrons contains a part having the finite range ~30 km, which is too short to affect the planetary motions, yet is too long to allow an easy detection by laboratory experiments. The gravity constant G_∞ for large distances is equal to $^3/_4$ of G which is measured by the Cavendish type experiment. In order to reproduce the gravity observed on the earth surface, one must assume the earth mass which is $^4/_3$ times as large as the usual estimate. Preliminary but careful analyses indicate that contrary to a naive suspicion there would be no immediate contradictions with the known properties of the earth, although the model on the inside of the earth should be subject to considerable changes. Some experiments are suggested to detect the proposed intermediate-range gravity. Other consequences are also discussed. (auth)

26755 RESPONSE OF A GRAVITATIONAL-WAVE ANTENNA TO A POLARIZED SOURCE. Tyson, J. A. (Bell Telephone Labs., Inc., Murray Hill, N. J.); Douglass, D. H. Phys. Rev. Lett.; 28: No. 15, 991-4(10 Apr 1972).

The response of a gravitational wave antenna to linear, mixed, and randomly polarized sources is studied as a function of sidereal time, source coordinates, and antenna location and orientation. It is found that the gravitational signals reported by Weber cannot be highly polarized tensor radiation coming from a single source at the Galactic nucleus. (auth)

26756 INTERPRETATION OF GRAVITATIONAL-WAVE OBSERVATIONS. Misner, C. W. (Univ. of Maryland, College Park). Phys. Rev. Lett.; 28: No. 15, 994-7(10 Apr 1972).

If Weber's gravitational-wave observations are interpreted in terms of a source at the galactic center, both the intensity and the frequency of the waves are more reasonable if the source is assumed to emit in a synchrotron mode (narrow angles, high harmonics). Although presently studied sources for such modes are astrophysically unsatisfactory—high-energy, nearly circular, scattering orbits—other possible sources are under study. (auth)

26757 GRAVITATIONAL SYNCHROTRON RADIATION IN THE SCHWARZSCHILD GEOMETRY. Misner, C. W.; Breuer, R. A.; Brill, D. R.; (and others) (Univ. of Maryland, College Park). Phys. Rev. Lett.; 28: No. 15, 998-1001(10 Apr 1972).

The existence of a mechanism for gravitational synchrotron radiation is demonstrated in solutions of the wave equation in the Schwarzschild background, with the source a particle in a highly relativistic circular geodesic. The main features (high-frequency harmonics, narrow angular distribution in latitude) are shown to hold for vector (electromagnetic) and tensor (gravitational) radiations, which are expected to be strongly polarized in the orbit plane. Detailed formulas for the spectrum are given in the scalar case. (auth)

26758 POST-NEWTONIAN GRAVITATIONAL RADIATION FROM POINT MASSES IN A HYPERBOLIC KEPLER ORBIT. Hansen, R. O. (Univ. of Chicago). Phys. Rev., D; 5: No. 4, 1021-3(15 Feb 1972).

The energy and the angular momentum radiated away in the form of gravitational waves from a system of two point particles with positive total energy are calculated in the lowest nonvanishing post-Newtonian approximation. By these radiations a particle arriving from infinity can be captured, and the cross section for such captures is determined as a function of the energy at infinity. The radiation from elliptic (bound) orbits can also be inferred, and is found to be in agreement with known results. (auth)

26759 CONSERVATION OF MOMENTUM IN GENERAL RELATIVITY. Price, Clifton William Jr. Providence; Brown Univ. (1971). 38p. University Microfilms Order No. 72-8163. Thesis.

Methods of describing the momenta of systems consisting of matter and fields in the context of general relativity, and those complications which arise from the requirements of covariance and the coupling of matter and fields are discussed. A complete description of momenta by means of the pseudotensor technique

is developed for three cases: (1) A static, uniformly dense universe in the linearized theory of general relativity. (2) An empty universe having nonzero cosmological constant in the linearized theory of general relativity. (3) A static, uniformly dense universe in the linearized Brans–Dicke theory. For each of these three cases the techniques mentioned above are applied to the complete momentum balance of a light pulse. By introducing a suitable pseudotensor it is demonstrated that momentum is conserved in each case. The red shift of the photon and the effect of the expansion of the universe on the momentum balance are also discussed. It is shown that this expansion is of negligible consequence in regions which are small compared to the optical radius of the universe. (Diss. Abstr. Int., B)

26760 MEASURABILITY ANALYSIS OF THE ELECTRIC-TYPE COMPONENTS OF THE LINEARIZED GRAVITATIONAL RADIATION FIELD. Smith, Gerrit Joseph. Syracuse, N. Y.; Syracuse Univ. (1971). 64p. University Microfilms Order No. 72-6624.

Thesis.

The equivalence principle and the theory of quantized Pauli–Fierz spin-two fields impose restrictions on a measurability analysis of weak gravitational fields to which Bohr and Rosenfeld's inquiry into the electromagnetic field is not subject. Atomic elastic structures whose parameters (masses, total volume, lattice and elastic constants) are considered adjustable are proposed as gravitational field detectors satisfying those restrictions. The limitations imposed by the uncertainty principle and by the radiation reaction of the detectors on the determination of the amplitude, frequency, and direction of the field are then exhibited. Finally, the relevance to the investigation of De Witt and to Einstein's full theory of gravitation is briefly considered. (Diss. Abstr. Int., B)

26761 SINGULARITIES, SOURCES OF CERTAIN STATIONARY METRICS. Leaute, Bernard (Univ., Paris). Ann. Inst. Henri Poincare, Sect. A; 15: No. 3, 243-73(Oct-Nov 1971). (In French).

The singularities of Reissner–Nordstrom, Newman–Unti–Tamburino, Kerr metrics were studied using the method developed by L.Bel for the Schwarzschild metric. In the first two cases a point singularity is demonstrated where the sources of the gravitational and electric fields are localized for Reissner–Nordstrom's solution. In the third case, that of Kerr's metric which is characterized by two parameters m and a, point or linear singularity occurs according to whether $m/a > 1$ or $m/a < 1$. The study is considered only for the case where $m/a > 1$; it is seen that the singular point is the support of two mathematical distributions, the first characterizing the massive aspect of the source, and the second demonstrating an intrinsic rotation of the source. (France)

26762 ELEMENTARY PARTICLES AND GENERAL RELATIVITY. Ross, D. K. (Iowa State Univ., Ames). Nuovo Cim.; 8A: No. 3, 603-10(1 Apr 1972).

An elementary particle is found to adjust its radius out to the point where the gravitational potential is minimum or to where the effective gravitational force is zero. By means of this principle, the usual well-known relationship between the mass and radius of the electron is found through the electromagnetic interaction and the Reissner–Nordström metric. Much more interesting results for the proton are found in the case of the strong interactions. Predicted radii agree well with experimental values. These relatively simple results suggest that general relativity may play a role in elementary-particle structure. (auth)

26763 MAGNETIZED DEFORMABLE MEDIA IN GENERAL RELATIVITY. Maugin, G. A. (Princeton Univ., N. J.). Ann. Inst. Henri Poincare, Sect. A; 15: No. 4, 275-302(Nov-Dec 1971).

A variational formulation is developed for the field equations, jump conditions across a discontinuity surface, and nonlinear constitutive equations for a magnetized elastic medium with finite deformations in the frame of the general theory of relativity. (France)

26764 GAUGE FIELDS AND GRAVITATIONAL FIELD EQUATIONS. Carmeli, M. (Aerospace Research Labs., Wright-Patterson Air Force Base, Ohio). Nucl. Phys.; B38: No. 2, 621-7(1972).

It is shown that the gravitational field equations in free space have a similar form to the free Yang–Mills field equations, where the group SL(2,C) replaces the group SU(2). The Ricci rotation coefficients take the role of the Yang–Mills like potentials, whereas the Riemann tensor takes the role of the gauge fields. (auth)

26765 BOUND GEODESICS IN THE KERR METRIC. Wilkins, Daniel C. (Stanford Univ., California. Princeton Univ., N. J.). Phys. Rev., D; 5: No. 4, 814-22(15 Feb 1972).

The bound geodesics (orbits) of a particle in the Kerr metric are examined. (By "bound" is meant that the particle ranges over a finite interval of radius, neither being captured by the black hole nor escaping to infinity.) All orbits either remain in the equatorial plane or cross it repeatedly. A point where a nonequatorial orbit intersects the equatorial plane is called a node. The nodes of a spherical (i.e., constant radius) orbit are dragged in the sense of the spin of the black hole. A spherical orbit near the one-way membrane traces out a helix-like path lying on a sphere enclosing the black hole. (auth)

26766 NOTE ON THE NONLINEAR EFFECT IN THE LORENTZ COVARIANT THEORY OF GRAVITATION. Fagundes, H.; Zimerman, A. H. (Instituto de Fisica Teorica, Sao Paulo, Brazil). Lett. Nuovo Cim.; 3: No. 14, 593-8(1 Apr 1972).

The nonlinear effect in the Lorentz covariant theory of gravitation according to Thirring and to Feynman, who used the non-conserved energy-momentum tensor as the source of the gravitational field is discussed. A general form of a conserved energy-momentum tensor is constructed along lines similar to the Belinfante and Rosenfeld symmetric energy-momentum tensor, and is used to treat the static nonlinear term. (L.B.S.)

Scattering Theory

Refer also to abstracts 26646 and 26880.

26767 RELATIVISTIC EIKONAL APPROXIMATION FOR INELASTIC PROCESSES. Harrington, D. R. (Rutgers–The State Univ., New Brunswick, N. J.). Acta Phys. Pol.; B3: No. 1, 95-104(Jan-Feb 1972).

The eikonal approximation for the contributions to inelastic scattering from arbitrarily crossed ladder graphs is considered. The particle represented by one of the "side-pieces" of the ladders is allowed to change its state and mass at each rung; the other side-piece particle is restricted to have at most one change of state, and that only if its elastic interactions are the same in the two states. When the denominators of the latter side-piece can be linearized the amplitudes reduce to forms essentially identical to those found in non-relativistic coupled-channel potential theory. This result is independent of the ratio of the energy to the side-piece mass and connects smoothly the non-relativistic and extreme relativistic regimes. Its implications for absorptive models are discussed briefly. (auth)

26768 DETAILED WAVE EQUATION AND DUAL AMPLITUDE. RELATIVISTIC QUANTUM DYNAMICS OF STRING MODEL OF HADRONS. Takabayasi, Takehiko (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 46: No. 6, 1924-36(Dec 1971).

The dual amplitude is derived for the case where the system is coupled to the external neutral scalar field $\phi(X)$ in the string model of hadrons. The general postulate of detailed wave equation is applied, under the postulate that the coupling occurs at a point on the string locally. The two-parameter formalism is also treated. (L.B.S.)

26769 CONSTRUCTION OF FOURIER–BESSEL TRANSFORMS OF SCATTERING AMPLITUDES. Kamal, A. N. (Rutherford High-Energy Lab., Chilton, Eng.). Lett. Nuovo Cim.; 3: No. 13, 529-36(25 Mar 1972).

An exact method is proposed for construction of the Fourier-Bessel transform of the scattering amplitude using the spin amplitudes rather than the helicity amplitudes. The problems associated with the use of helicity amplitudes are also discussed. (L.B.S.)

26770 PADE APPROXIMANTS FOR SCATTERING BY A SPHERICAL WELL. Colegrave, R. K.; Streams, B. F. (London Univ.). Lett. Nuovo Cim.; 3: No. 13, 551-6(25 Mar 1972).

Pade approximants are used to calculate bound states and phase shifts for a spherical well potential which is free of interaction singularities. (L.B.S.)

26771 IMPACT-PARAMETER REPRESENTATIONS IN POTENTIAL SCATTERING. Kamal, A. N.; Chavda, L. K. (Univ. of Alberta, Edmonton). Phys. Rev., D; 5: No. 4, 994-1001(15 Feb 1972).

Starting from the Lippmann–Schwinger equation the off-energy-shell generalizations of the Glauber amplitude and the Blankenbecler–Goldberger amplitude are derived for potential scattering.

The Lippmann–Schwinger equation for partial waves treated as a Fredholm equation is solved and the high-energy limit studied. (auth)

26772 EIKONAL APPROXIMATION AND THE LIGHT CONE. Eichten, E. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 5: No. 4, 1047-52(15 Feb 1972).

The high-energy behavior of a particle of arbitrary spin interacting with an external potential $A_{\mu_1\cdots\mu_n}(x)$ by means of a $J^{\mu_1\cdots\mu_n}A_{\mu_1\cdots\mu_n}(x)$ interaction is considered, where $J^{\mu_1\cdots\mu_n}$ is a function of the fields and their derivatives. A general relation between the exponentiation of the eikonal approximation and light-cone commutators is obtained. (L.B.S.)

26773 FACTORIZATION OF MULTI-REGGE AMPLITUDES. II. Weis, J. H. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 5: No. 4, 1043-7(15 Feb 1972).

Some general comments are made on the relationship between the factorization of multi-Regge amplitudes and the singularity structure of multiparticle amplitudes. A close relationship is found to exist between the validity of factorization and the absence of simultaneous discontinuities in overlapping variables suggested by the Steinmann relations. (auth)

26774 SOLUTION OF THE AMATI–BERTOCCHI–FUBINI–STANGHELLINI–TONIN EQUATION WITH A RESONANCE KERNEL. Chan, C. F.; Webber, B. R. (Univ. of California, Berkeley). Phys. Rev., D; 5: No. 4, 933-42(15 Feb 1972).

The solution of the Amati–Bertocchi–Fubini–Stanghellini–Tonin multiperipheral integral equation with a narrow-resonance kernel is investigated. First, an approximation scheme that leads to a tractable analytic approximate solution is presented for both the forward and nonforward equations. Next, the exact numerical solutions are displayed for the relevant values of the input parameters: These results serve as a measure of the accuracy of various analytic approximate solutions. The approximate solution presented here, which is found to be good to within about 10% in the region of interest, should be useful both in the general study of the output of the multiperipheral model and in the Pomeranchukon perturbation theory. (auth)

26775 SELF-CONSISTENT POMERANCHUKON SINGULARITIES. II. Bronzan, J. B. (Rutgers–The State Univ., New Brunswick, N. J.); Hui, C. S. Phys. Rev., D; 5: No. 4, 964-9(15 Feb 1972).

It is assumed that the Pomeranchukon poles lie on Schwarz trajectories: $\alpha_+(t) = 1 \pm \gamma t^{\frac{1}{2}} + g(t)$. A functional self-consistency equation is developed for g(t) based on t-channel unitarity, and it is found that near t = 0, g(t) has the behavior $(\text{const})^2 t^{\frac{1}{2}}(-\ln t)^{\frac{1}{2}}$. Finally, an expression is obtained for the t-channel partial wave and the high-energy limit of the scattering amplitude in the s channel is determined. (auth)

26776 ASPECTS OF RELATIVISTIC POTENTIAL SCATTERING. Bawin, Michel Constant. Bloomington, Ind.; Indiana Univ. (1971). 64p. University Microfilms Order No. 72-6749.

Thesis.

A model for the elastic scattering of two particles in the presence of inelastic processes is proposed, in which a complex nonlocal potential simulating the presence of inelastic channels is taken to be separable. In particular, the form of a complex separable interaction leading to linear Regge trajectories, Regge behavior, and a finite cross section at infinite energy is given. The model can also be used as a guide as to what properties a separable potential fitting some low and intermediate energy data should have, and find some possible application in the three-body problem. A study is made of the analytic properties of the partial-wave scattering amplitude for 2 particles of equal mass m and of energy E in the center-of-mass system, in the framework of the quasi-potential equation in relativistic space of Kadyshevsky as modified by Freeman. The main result is that, for analytic potentials V(z) such that $|V(z)| < \exp(-a|z|)$, the partial-wave scattering amplitude is a memorphic function of X (cosh X = E/m); poles in the upper half of the X-plane correspond to a bound state and must lie on the imaginary axis. (Diss. Abstr. Int., B)

26777 APPROXIMATE SOLUTIONS TO QUANTUM MECHANICAL THREE-BODY PROBLEMS. Grubman, Ronald. San Diego, Calif.; Univ. of California (1971). 135p. University Microfilms Order No. 72-4020.

Thesis.

Various solutions to the quantum mechanical three body problem are explored. An angular momentum decomposition of the Faddeev equations for the general case of three particles with spin is developed. The formalism is applied to calculate the binding energy of two alpha particles and a neutron, obtaining an energy of 1.22 ± .05 MeV, which compares with the experimental value of 1.57 MeV for the three particle break-up energy of ^{9}Be. A Padé approximant is derived for the T-matrix whose elements describe the scattering of any one particle from a bound state of the other two. It is shown that under certain conditions this solution has much of the known structure of the exact T-matrix. The problem of neutron-deuteron S-wave scattering is investigated using an N/D approximation. The first two terms of the Born series for the exact amplitude (calculated explicitly from the Faddeev equations) are used to derive expressions for N(S) and D(S), including a simple approximation to the inelastic cut above the three-body breakup threshold. The resulting equations are used to describe the $J = \frac{1}{2}$ and $J = \frac{3}{2}$ S-wave scattering amplitudes for the neutron-deuteron problem. The effective range curves (q Cot δ) for both amplitudes are in reasonable agreement with the data up to the highest energies at which such data are available. Additionally, in the $J = \frac{1}{2}$ amplitude, a triton pole is found which is fixed at the experimental value by varying a parameter. The residue at the pole has the correct sign for a bound state. (Diss. Abstr. Int., B)

26778 RELATIVISTIC THREE-BODY PROBLEM IN RELATIVE VARIABLES. Vinogradov, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 10: No. 3, 338-48 (Mar 1972). (In Russian).

On the basis of the three-dimensional formulation of quantum field theory the Lorentz-covariant three-body theory is constructed in the momentum space. Relativistic Jacoby momenta are introduced by means of the addition operation for 4-vectors in the Lobachevsky space. It is shown that the center of mass motion can be singled out, and the problem is formulated in the relative variables only, as a direct generalization of the nonrelativistic theory. Three-dimensional relativistic analogs of the Faddeev equations for scattering amplitudes are obtained as well as the analog of the Schrödinger equation for three-body system. The system satisfies the three-body unitarity and the correspondence principle. (auth)

26779 SPECTRAL SOURCE-LIKE EXPANSIONS IN THEORY OF WAVE PROPAGATION AND QUANTUM THEORY OF POTENTIAL SCATTERING. Golichev, I. I.; Krasnushkin, P. E. (Mathematics Inst., Moscow). Teor. Mat. Fiz.; 10: No. 3, 370-87 (Mar 1972). (In Russian).

Spectral source-like expansions (i.e., expansions over the normal waves) for the problems of theory of wave propagation and quantum theory of potential scattering are constructed and investigated by means of linear nonself-adjoint differential operators. (auth)

26780 BREAKDOWN OF SIMPLE CANCELLATION IN THE OPERATOR MULTIPLE-SCATTERING SERIES. Karlsson, B. R. (Inst. of Theoretical Physics, Goteborg); Namyslowski, J. M. Nuovo Cim.; 8A: No. 3, 520-24(1 Apr 1972).

The Watson multiple-scattering series for a three-body problem is considered in the eikonal approximation. The sum of the series, i.e., the off-shell three-body transition amplitude, is expressed in closed form entirely in terms of off-shell two-body transition amplitudes. The result shows that the simple cancellation that occurs in the eikonal multiple-scattering series for the on-shell amplitude breaks down for the off-shell amplitude. (auth)

26781 SPACE–TIME PICTURE OF POLE DOMINANCE AT HIGH ENERGY. Orzalesi, C. A. (New York Univ., N. Y.). Phys. Lett.; 38B: No. 7, 538-40(3 Apr 1972).

The properties of the space–time correlation function for a high-energy Regge-behaved pole dominance amplitude are studied. (auth)

26782 RESTRICTION ON THE SCATTERING AMPLITUDE GROWTH AT FINITE ENERGY. Vernov, Yu. S.; Mnatsakanova, M. N. (Lebedev Inst. of Physics, Moscow). Teor. Mat. Fiz.; 10: No. 1, 33-46(Jan 1972). (In Russian).

The relation between the phase and the modulus of the scattering amplitude at arbitrary energy is studied on the basis of analyticity and unitarity requirements. The restriction on the growth of the amplitude is found. (auth)

26783 LORENTZ POLES IN A PARTICLE EXCHANGE MODEL. Harnad, J. P. (Oxford Univ.). Nucl. Phys.; B38: No. 2, 350-64(1972).

Making a choice for the off-mass-shell continuation of the propagator for massive spin-J particles which is traceless at all momenta, Lorentz poles are constructed in the Van Hove model. Replacement of the bare propagator with a unitarized one does not destroy the t = 0 structure and yields families of J-plane poles which move with energy. The extrapolation away from t = 0 is consistent with results obtained from analyticity arguments. (auth)

26784 INDEFINITELY RISING REGGE TRAJECTORY AND FINITE ENERGY SUM RULE. Aly, H. H. (Southern Illinois Univ., Edwardsville); Basri, S.; Muller, H. J. W. Particles Nucl.; 2: No. 6, 365-8(Dec 1971).

Finite energy sum rules (FESR) are used to investigate the asymptotic nature of the Regge trajectory Re α (s) as a function of s. Bound on the rate of rise of Re α (s) and the rate of decrease of the resonance width is established within the FESR framework. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

26785 BEHAVIOUR OF ^{4}He IN DILUTE LIQUID MIXTURES OF ^{4}He AND ^{3}He. Laheurte, J. P. (Centre de Recherches sur les Tres Basses Temperatures, Grenoble, France); Keyston, J. R. G. Cryogenics; 11: No. 6, 485-6(Dec 1971).

Experiments on dilute liquid mixtures of ^{4}He and ^{3}He, for different ^{4}He molar concentration x_4, have shown (Keyston and Laheurte, Phys. Lett., 24A: 132(1967)) that a superfluid film appears below a critical temperature $T_F(x_4)$, higher than the phase-separation temperature $T_S(x_4)$. Results are given here that clarify the behavior of ^{4}He in liquid ^{3}He and which explain how the concentration of the mixture can change during the course of an experiment. The results obtained for phase separation in a range of concentration $2 \times 10^{-2} \lesssim x_4 \lesssim 2.2 \times 10^{-1}$ are shown and compared with previous measurements. These results fit theoretical predictions in which the ^{4}He impurities behave like a gas of quasi particles with an energy spectrum, $\epsilon = E^4 + p2/2m$. The binding energy was found to be $E^4 \simeq -6.61$K and the effective mass $m^* = 4.5\ m_4$, where m_4 is the mass of a ^{4}He atom. (UK)

26786 SPECTROSCOPIC STUDIES OF METASTABLE ATOMIC AND MOLECULAR BUBBLE STATES IN ELECTRON-BOMBARDED SUPERFLUID LIQUID HELIUM. Hill, Joseph Clifton Jr. Houston, Tex.; Rice Univ. (1971). 98p. University Microfilms Order No. 71-26,298.

Thesis.

Infrared absorption studies of electron-bombarded superfluid liquid helium in the region 8000 to 24000 Å established the metastability of the $a^3\Sigma_u^+$ molecular state in the liquid. These studies also indicated that the 2^3S metastable atom is present under the same conditions. Electronic transitions identified as the $c^3\Sigma_g^+ \leftarrow a^3\Sigma_u^+$ and $b^3\Pi_g \leftarrow a^3\Sigma_u^+$ and $2^3P \leftarrow 2^3S$ were recorded, using standard techniques of infrared absorption spectroscopy on a sample of pure liquid helium excited by impact of 160-keV electrons. The molecular transitions are rich in vibrational and rotational structure and there is evidence that vibrational levels as high as $v = 2$ and rotational levels as high as $N = 29$ are populated in the $a^3\Sigma_u^+$ molecular state. Fractional absorption measurements have shown that the density of $a^3\Sigma_u^+$ molecular states is of the order of 10^{13}/cm^3 in an excitation volume approximately 0.05 cm^3 for 1-μA bombarding beam of 160-keV electrons. The amount of absorption and thus the number density of absorbers manifests a square root dependence on the exciting beam current, indicating that $a^3\Sigma_u^+ - a^3\Sigma_u^+$ collisions are primarily responsible for de-excitation of $a^3\Sigma_u^+$ molecular states. Absorption decay studies using a pulsed beam of bombarding electrons give further evidence that the a–a encounter is the principal destruction mechanism of $a^3\Sigma_u^+$ molecular states, with a rate coefficient approximately 4×10^{-10} cm^3/sec. The decay of 2^3S states is approximately exponential, with a lifetime of ~0.7 msec. Estimates of the widths of rotational components in the (0–0) band of the $b^3\Pi_g \leftarrow a^3\Sigma_u^+$ transition were obtained by using measured relative intensities and calculated transition probabilities of resolved rotational features in a computer-generated reconstruction of unresolved portions of the (0–0) band. A similar technique was applied to the (0–0) band of the $c^3\Sigma_g^+ \leftarrow a^3\Sigma_u^+$ transition. Using line width as a best-fit parameter yielded figures of 22 cm^{-1} and 73 cm^{-1} as rotational component line widths of the $b^3\Pi_g \leftarrow a^3\Sigma_u^+$ and $c^3\Sigma_g^+ \leftarrow a^3\Sigma_u^+$ transitions, respectively. Comparisons of experimental results with recently developed theories of spectral line shift and line broadening show that there is configurational interaction of excited states with the host fluid and favor the notion that these states exist in stable voids or bubbles about 12 Å in diameter. These theories explain differences in spectral shift and line width that have been observed in emission and absorption, and are encouraging in their quantitative predictions of these phenomena. Both theories point up the important if subtle role that the van der Waals force plays in such configurational interactions. (Diss. Abstr. Int., B)

26787 VERY LOW-TEMPERATURE SPECIFIC HEAT OF SUBMONOLAYER HELIUM FILMS. Hickernell, D. C.; McLean, E. O.; Vilches, O. E. (Univ. of Washington, Seattle). Phys. Rev. Lett.; 28: No. 13, 789-92(27 Mar 1972).

The specific heats of ^{3}He and ^{4}He films adsorbed on exfoliated graphite were measured between 0.04 and 4.2 K, for fractional monolayer coverages between 0.25 and 0.63. ^{3}He films show anomalies around 0.1 K that are absent in the ^{4}He results. A possible explanation is given in terms of spin ordering of the ^{3}He atoms. (auth)

26788 DYNAMICS OF ATOMIC AND MOLECULAR METASTABLE STATES PRODUCED IN ELECTRON-BOMBARDED SUPERFLUID HELIUM. Keto, J. W.; Stockton, M.; Fitzsimmons, W. A. (Univ. of Wisconsin, Madison). Phys. Rev. Lett.; 28: No. 13, 792-5(27 Mar 1972).

The production, destruction, and lifetimes of the $He_2(a^3\Sigma_u^+)$ and $He(2^3S)$ metastable states of helium that are produced in electron-bombarded superfluid helium were studied. The characteristic lifetime of a metastable molecule in the superfluid is shown to exceed 0.1 sec, while the lifetime of a metastable atom is only about 15 μsec. The production rates for the $He_2(a^3\Sigma_u^+)$ and $He(2^3S)$ metastable states are about 500 and 450 per incident 160-keV electron, respectively. (auth)

26789 THEORY OF SUPERFLUIDITY IN STRONGLY INTERACTING MANY-FERMION SYSTEMS WITH APPLICATIONS TO PURE NEUTRON MATTER AND SYMMETRICAL NUCLEAR MATTER. Yang, Chia-hsiung. St. Louis; Washington Univ. (1971). 157p. University Microfilms Order No. 72-9375.

Thesis.

A product of a Jastrow correlation factor $\prod_{i<j} f(r_{ij})$, and a model wave function Φ of Bardeen–Cooper–Schrieffer (BCS) type is proposed as trial wave function for the superfluid ground state of strongly interacting many Fermion systems. The resulting energy expectation value is cluster expanded in $\eta = f^2 - 1$, the successive terms involving successively higher-order density matrices for the BCS function alone. This expansion, when truncated at the two-body cluster terms, yields a theory essentially the same as that of BCS, except that the bare potential $v(12)$ appearing in the BCS gap equation is replaced by an effective potential $w(12) = \hbar^2/M(\nabla f(r_{12}))^2 + f^2(r_{12}) - v(r_{12})$. The method allows for the first time a consistent treatment of superfluidity in nuclear systems, where $v(12)$ is typically singular but $w(12)$ is well-behaved for a suitable chosen two-body correlation factor. Numerical applications of the theory to pure neutron matter, symmetrical nuclear matter, and neutron star matter are described. (Diss. Abstr. Int., B)

26790 LIGHT SCATTERING FROM FIRST AND SECOND SOUND GENERATED BY A PERIODICALLY HEATED SURFACE IN SUPERFLUID ^{4}He AND ^{3}He–^{4}He MIXTURES. Petrac, Dusan. Los Angeles; Univ. of California (1971). 99p. University Microfilms Order No. 72-5858.

Thesis.

Light scattering is employed for the detection of the second- and first-sound modes, which are simultaneously generated by a periodically heated surface layer in superfluid ^{4}He and in 11 and 20 mole % ^{3}He–^{4}He mixtures. The sound modes are generated with power inputs of 1 mW/cm^2 at frequencies from 600 KHz to 2.2 MHz and from temperatures of 1.29 to 2.17°K. The light scatters from the periodic spatial and temporal modulation of the dielectric constant of the superfluid. This modulation is brought about in ^{4}He by the density oscillations, and in He–^{4}He mixtures by the density and concentration oscillations associated with the sound wave. The weak scattered light is shifted in frequency and forms a beat note with unshifted light which is then heterodyne detected. When the Bragg scattering condition is satisfied, the second sound velocity in the superfluid can be measured. In ^{4}He the temperature dependence of the amplitude of the light scattered from second sound supports the theoretical predictions of Lifshitz. The Debye–Sears effect is utilized for the detection of the very weak first sound excited by the heater. The angular spread of the laser beam and small scattering angles limit the usefulness of this technique for the determination of the attenuation coefficient of the second sound. (Diss. Abstr. Int., B)

26791 TEMPERATURE DEPENDANCE OF THE VORTEX CORE RADIUS IN He II. Steingart, Marvin. New Brunswick, N. J.; Rutgers–The State Univ. (1972). 103p. University Microfilms Order No. 72-9678.

Thesis.

Using a newly developed time-of-flight technique, the temperature dependence of the size of the vortex core radius in He II in the range $.35K \leq T \leq .60K$ was measured. The results are in agreement with the earlier work of Rayfield and Reif at $T = .28K$ and with a model of the vortex core proposed by Glaberson, Strayer and Donnelly. They disagree with a theory due to Pollock. The precision of the measurements permitted the observation of differences in the dynamics of oppositely charged vortex rings in the same electric field configurations. These differences were qualitatively accounted for in a simple way by incorporating the frictional drag associated with the ion bound on the vortex core into the equations of motion. The results suggest that the free-ion wave function is not greatly distorted by its presence on the vortex core, nor is the ion strongly shielded by the vortex velocity field. (Diss. Abstr. Int., B)

26792 NEUTRAL EXCITATIONS FROM A TRITIUM SOURCE IMMERSED IN He II. Mitchell, R. P.; Rayfield, G. W. (Univ. of Oregon, Eugene). Phys. Lett.; 37A: No. 3, 231-2(22 Nov 1971).

It is shown that energetic neutral excitations are produced by a β^- source, provided a large electric field is applied in the source region. (auth)

26793 MACROSCOPIC QUANTUM PHASE COHERENCE IN SUPERFLUIDS: THEORY. Scalapino, D. J. (Univ. of California, Santa Barbara). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 195-201(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The theory of macroscopic quantum phase coherence is reviewed, and its relationship to measurements of fundamental constants is discussed. The off-diagonal matrix elements that characterize this state of matter are introduced, and the functional dependence of their phase on the physical constants, potentials, lengths, and times are established. The effects of fluctuations and nonequilibrium conditions on measurements are discussed. (auth)

26794 INFLUENCE ON THE FUNDAMENTAL CONSTANTS OF A PRECISE MEASUREMENT OF THE JOSEPHSON EFFECT IN LIQUID HELIUM. Khorana, B. M.; Douglass, D. H. Jr. (Univ. of Rochester, N. Y.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 249-50(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

Using the analog of the a-c Josephson effect in superfluid helium, it should be possible to determine the product h/M_{He}, where h is Planck's constant and M_{He} is the mass of the helium atom, to an accuracy of a few ppM. The implications of such a measurement for the fundamental constants are discussed. (auth)

Superconductivity

Refer also to abstracts 25694, 26091, 26160, 26479, 26745–26748, 27334, and 27343.

26795 (AD-733710) CURRENT NOISE IN JOSEPHSON POINT CONTACTS. Report for July–December 1969. Kanter, Helmut; Vernon, Frank L. Jr. (Aerospace Corp., El Segundo, Calif.). 1 Nov 1972. Contract F04701-71-C-0172. 15p. (SAMSO-TR-71-275). NTIS.

The dependence and magnitude of noise currents in superconducting point contacts on dc current and voltage was measured. The results are in good agreement with the theoretical predictions of Scalapino and Stephen. As expected, in the shot-noise limit at sufficiently high junction voltage, the noise current does not vary with temperature. (auth) (NTIS)

26796 TUNNELING INTO WEAKLY COUPLED COPPER AND LEAD IN PROXIMITY. Vrba, J.; Woods, S. B. (Univ. of Alberta, Edmonton). Can. J. Phys.; 49: No. 24, 3133-41(15 Dec 1971).

Tunneling experiments from superconducting Al base electrodes into both sides of weakly coupled Pb/Cu proximity sandwiches were performed. The temperature variation and energy of multiple-peaked structure in the normalized tunneling conductance curves compare very well with those calculated using the McMillan tunneling model of the proximity effect, although the calculated curves exhibit more sharply peaked structure than the observed ones. A simple model, which takes into consideration the thickness inhomogeneities in the proximity sandwich, is proposed in order to account for the sharpness differences. (auth)

26797 QUANTUM KINETICS OF PHASE TRANSITIONS AT TEMPERATURES CLOSE TO ABSOLUTE ZERO. Lifshits, I. M.; Kagan, Yu. (Inst. of Physical Problems, Moscow). Zh. Eksp. Teor. Fiz.; 62: No. 1, 385-402(Jan 1972). (In Russian).

At absolute zero, formation of the nuclei of a new phase cannot be due to thermal fluctuations and must be ascribed to a quantum mechanism. Calculation of the respective probabilities can be carried out in the quasi-classical approximation. This means that formation of nuclei can be reduced to tunnel movement of the system along an optimal trajectory in configuration space passing under the energy barrier separating the initial metastable state from a state with a real nucleus. In the opposite cases—near phase equilibrium pressure and near the lability boundary of the initial phase—the critical quantum fluctuations that lead to formation of a real nucleus possess macroscopic dimensions. The sequence of virtual intermediate states is described macroscopically, and is qualitatively different in the two limiting cases. The formulas obtained express the unknown probabilities in terms of various thermodynamic characteristics of the system. (auth)

26798 PROXIMITY EFFECT IN PARALLEL MAGNETIC FIELDS. Todd, R. J.; Chen, J. T.; Kim, Y. W. (Wayne State Univ., Detroit). Phys. Rev., B; 5: No. 7, 2518-25(1 Apr 1972).

The parallel nucleation field H_0 at the boundary between superconducting and normal-metal layers was measured as a function of temperature. In addition, measurements of the perpendicular critical field of the superconductor and the conductivity of the respective metal layers were performed. The experimental results are compared with the general theories of Fink and Presson (1970) and Fink and Martinoli (1971). Consequences of the choice of the theoretical boundary conditions imposed on the order parameter and the extension of Ginzburg–Landau equations to temperatures far below the transition temperature are discussed. (auth)

26799 SUPERCONDUCTING TRANSITION TEMPERATURES OF DILUTE INDIUM-BASED ALLOYS. Williamson, J. D.; MacLaughlin, D. E. (Univ. of California, Riverside). Phys. Rev., B; 5: No. 7, 2738-40(1 Apr 1972).

An anomalous dependence of superconducting transition temperature on solute concentration in very dilute InCd, InHg, and InTl alloys reported previously has been confirmed in a series of measurements on these and other In-based alloy systems. Systematics of the anomalous behavior are discussed. In particular, the divalence of both Cd and Hg in trivalent In suggests that solute electropositivity is a possible origin of the anomaly, and points to an effective electropositivity of Tl in In. (auth)

26800 SPECTRA OF ORGANIC MOLECULES PENETRATING INTO A METALLIC MATRIX AND THE EXCITON MECHANISM OF HIGH-TEMPERATURE SUPERCONDUCTIVITY. Agranovich, V. M.; Mekhtiev, M. A. (Inst. of Spectroscopy, Podolsk, USSR). Sov. Phys.-Solid State (Engl. Transl.); 13: No. 9, 2284-91(Mar 1972).

Translated from Fiz. Tverd. Tela; 13: No. 9, 2732-42(Sep 1971).

The renormalization of the spectrum and the quenching of excitons taking place as a result of the interaction of excitons with the conduction electrons in a metal are considered. The spectrum of an organic impurity molecule penetrating into the metallic matrix is also discussed. It is shown that in the absorption spectrum of the systems under consideration, in addition to the light absorption lines corresponding to the excitation of the organic molecules, absorption lines corresponding to the simultaneous excitation of the organic molecules and the metal also appear. The electron–electron interaction for high exciton concentrations is examined. The case of layer-like organometallic media is also discussed. (auth)

26801 JOSEPHSON JUNCTIONS WITH Nb/Al COMPOSITE ELECTRODES. Laibowitz, R. B.; Mayadas, A. F. (IBM Watson Research Center, Yorktown Heights, N. Y.). Appl. Phys. Lett.; 20: No. 7, 254-6(1 Apr 1972).

Josephson tunnel junctions were fabricated, incorporating a thin layer of normal metal that was oxidized to form the tunnel barrier. The tunnel devices tested were of the form $Nb/Al/Al_2O_3/Nb$, and several milliamperes of Josephson current were observed at 4.2°K. These samples were found to have better-defined tunneling characteristics than samples of the form $Nb/NbO_x/Nb$. (auth)

26802 SPIN–LATTICE RELAXATION NEAR THE SUPERCONDUCTING TRANSITION: A DETAILED ANALYSIS FOR V_3Pt. Silbernagel, B. G. (Univ. of California, Santa Barbara); Wernick, J. H. Phys. Rev., B; 5: No. 8, 3355-7(15 Apr 1972).

A detailed study was made of the spin–lattice relaxation of the ^{51}V nucleus in V_3Pt for temperatures just above the superconducting transition. The quantity $1/T_1T$ is found to remain constant down to T_c and has an average value $1/T_1T = 1.76 \pm 0.09$ $(K\ sec)^{-1}$. (auth)

26803 HIGHLY REGULAR DOMAIN MOTION IN THE DYNAMIC INTERMEDIATE STATE OF SUPERCONDUCTING TIN. Farrell, D. E.; Isett, L. (Case Western Reserve Univ., Cleveland). Phys. Rev., B; 5: No. 9, 3523-30(1 May 1972).

Using the Sharvin point-contact technique, the regularity of domain motion in the dynamic intermediate state of superconducting tin was investigated as a function of temperature, applied magnetic field, and transport current. It was found that, when the magnetic field is increased so as to lie in a range closer to the critical field than has been previously investigated systematically, an extremely drastic increase in the regularity of the motion occurs, independent of temperature and sample condition. It is suggested that this drastic increase represents the onset of motion of a modified Landau domain structure, freed from the perturbing influence of the ends of the sample. A new phenomenon of domain healing is reported in the highly regular regime. (auth)

26804 JOULE-HEATING POWER DISSIPATION IN A TYPE-II SUPERCONDUCTOR TUBE. Urban, Eugene W. (Marshall Space Flight Center, Huntsville, Ala.). Phys. Rev., B; 5: No. 9, 3530-42(1 May 1972).

The radial distribution of Joule-heating power dissipation in the wall of a hollow tube of Nb–25-at. % Zr was calculated for changing longitudinal applied magnetic field. The superconducting critical current density in the cylinder was assumed to obey the formula $J_c = \alpha_c \times (\mu_0 H_{c2} - B)/(B_0 + B)$, as reported elsewhere. The power-density distribution across the tube wall was calculated as the field increased and decreased from a series of cooled-in background fields representing the idealized physical situation following flux jumps. It was found that at each radial position in the tube the power-density function is far from monotonic. The function has a pronounced discontinuous amplitude increase and may have from one to as many as five changes in slope. For each radial position the power density can be displayed as a three-dimensional surface. Relative temperature changes to be expected in well-cooled and poorly cooled tubes were estimated from the power-density curves. (auth)

26805 ULTRASONIC ATTENUATION IN THE INTERMEDIATE STATE OF TIN. Singh, O.; Jericho, M. H. (Dalhousie Univ., Halifax, Nova Scotia). Phys. Rev., B; 5: No. 9, 3542-50(1 May 1972).

The ultrasonic attenuation was measured in high-purity Sn cylinders in the intermediate state. The laminar intermediate-state structure was set up with a rotating external field. Andreev's theory of sound attenuation in the intermediate state was extended to allow for arbitrary values of ql, the product of sound propagation vector and electron mean free path. It was then possible to determine the size of the normal regions as a function of applied magnetic field from the experimental data. The intermediate-state structure thus determined agreed reasonably well with the Landau model. The analysis suggests, however, that in the intermediate state the attenuation in the high-frequency limit is not increasing linearly with applied field as simple considerations would suggest. The reason for this is not properly understood at the present time. (auth)

26806 ABSOLUTE MEASUREMENT OF THE FAR-INFRARED SURFACE RESISTANCE OF Pb. Braendli, G.; Sievers, A. J. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., B; 5: No. 9, 3550-7(1 May 1972).

The far-infrared surface resistance of Pb was measured absolutely using a new technique of parallel-plate waveguides. These are made from two rolled-metal foils and a dielectric spacing material or by evaporating the metal directly on both surfaces of the dielectric and thus preventing the air from oxidizing the measured metal surface. Measurements of gold and lead at room temperature show good agreement with the Drude theory and illustrate the accuracy of the new technique. The low-temperature measurements of lead carried out between 6 and 280 cm^{-1} in the superconducting and normal state show the onset of the Holstein process (a simultaneous absorption of a photon and emission of a phonon by an electron) and the superconducting energy gap and fit a new sum rule for the surface resistance. The surface resistance of normal Pb agrees well with calculations by Scher, if impurity scattering is taken into account. The data are also compared with Shaw and Swihart's calculations for strong coupling superconductors. The far-infrared properties of the spacing materials, Teflon and polyethylene, used in this work are also given. (auth)

26807 SUPERCONDUCTING PARAMETERS AND SIZE EFFECTS OF ALUMINUM FILMS AND FOILS. Maloney, M. David; de la Cruz, Francisco; Cardona, Manuel (Brown Univ., Providence). Phys. Rev., B; 5: No. 9, 3558-72(1 May 1972).

The experimental results and analysis of the critical-field determination of aluminum films and foils are presented. The thermodynamic parallel and perpendicular critical fields were studied as a function of thickness and temperature. The measurement of the critical fields together with suitable theories allows the determination of the penetration depth λ, the coherence length ξ, and the surface-energy parameter Δ. The thermodynamic transition of all films studied was of second order. Measurement in both magnetic field orientations offers a check on the consistency of the methods used to analyze the data. The value of the Ginzburg–Landau parameter κ obtained from these measurements is six times larger than the value obtained from supercooling experiments. This phenomenon was observed previously by other authors in different metals. The superconducting transition of all foil samples was of first order. In perpendicular fields the transition to the intermediate state was analyzed by means of an interpolation formula having the correct theoretical behavior in the limits of both large and small thicknesses. The value of the surface-energy parameter so obtained is in agreement with the supercooling result. (auth)

26808 STABILITY OF SUPERCURRENTS IN CYLINDRICAL FILMS OF TIN. Phillips, H. Lawrence; Meissner, Hans (Stevens Inst. of Tech., Hoboken, N. J.). Phys. Rev., B; 5: No. 9, 3572-80(1 May 1972).

Using current pulses with a rise time of less than 0.5 nsec and a pulse length of 240 nsec, the stability of supercurrents in cylindrical films of tin was investigated. For current densities J in excess of the instability current density $J_I = J_I(0)\,[1 - (T/T_c)^4]$, the sample voltage rises with time as $a(J,T)f(t/t')$, where $f(t/t')$ is a universal function of t/t'. The time constants t' cover a range of 0.5 nsec < t' < 200 nsec. The amplitude coefficients a rise from zero as J exceeds J_I and then join onto the values $a = iR_\pi$, the voltage in the normal state. The time constants t' depend on current and temperature as $t' \approx t_0[J_I/(J - J_I) - \epsilon J_I^2/(J - J_I)^2]$, where $J_I(0)$ has values of the order of 15×10^5 A/cm^2 and $t_0 \approx 14$ nsec, while $\epsilon \sim 3 \times 10^{-3}$. (auth)

26809 SPEED OF MAGNETIC-FLUX PENETRATION AND EDDY-CURRENT DAMPING IN THIN-FILM SUPERCONDUCTORS. Huebener, R. P.; Stafford, L. G.; Aspen, F. E. (Argonne National Lab., Ill.). Phys. Rev., B; 5: No. 9, 3581-92(1 May 1972).

The resistive-voltage enhancement in the intermediate state of superconducting lead films in the presence of an oscillatory-magnetic-field component was investigated together with the penetration into the specimen of the magnetic field oscillation. The flux penetration was measured using small flat pickup coils sandwiched between two identical Pb films. The oscillatory field H_1 was parallel to the static field H_0, both being oriented perpendicular to the film plane. The ratio H_1/H_0 was 10^{-2} to 10^{-3}. The experiments were carried out varying the specimen film thickness, the static field, and the frequency and amplitude of the oscillatory field. Both the resistive voltage and the voltage generated in the pickup coil were found to pass through a maximum at approximately the same frequency of H_1. The results indicate that the resistive-voltage enhancement is caused by the oscillatory eddy currents in the specimen assoicated with the magnetic field oscillation. These eddy currents assist in overcoming the pinning forces thus reducing the influence of flux pinning. The frequency dependence of the effect can readily be understood from the relaxation time τ for magnetic-flux penetration yielding a maximum for $2\pi\nu\tau = 1$. A simplified treatment of the magnetic-flux penetration for the case of a demagnetizing factor close to 1 is given using an energy-balance argument due to Faber. The theoretical values of τ agree reasonably with the experimental values if the electrical conductivity in the expression for τ is obtained from the slope of the voltage-current curves and if the dependence of this slope upon magnetic field and current is taken into account. (auth)

26810 MAGNETOELASTIC PROPERTIES OF SUPERCONDUCTING NIOBIUM. Goodrich, G. W.; Lange, J. N. (Oklahoma State Univ., Stillwater). Phys. Rev., B; 5: No. 9, 3593-3604 (1 May 1972).

Changes in elasticity as a result of the superconducting transition are observed in high-purity niobium. The stiffness changes in niobium are quite anisotropic and dependent on the acoustic mode, suggesting a microscopic mechanism dependent on the crystalline symmetry, perhaps through the band structure. Imperfections and impurities have little effect on the stiffness changes. A residual stiffness resulting from trapped vortices is used to calculate the forces binding the vortices to imperfections. The magnitudes of the binding forces suggest a stronger binding mechanism than provided by elastic gradients that might be associated with a dynamic interaction between the vortex and the motion of dislocations. The attenuation of the acoustic wave is observed to decrease upon entering the mixed state and finally to increase rapidly to its normal-state value at the second critical field (H_{c2}). The decrease in attenuation is interpreted as being due to the pinning of free dislocation segments by vortices, which leads to a mismatch between the acoustic wave and the dislocation system and a resulting decrease in the energy absorbed from the acoustic wave. At fields immediately above H_{c2}, small changes in attenuation are observed which may be attributed to the presence of fluctuating Cooper pairs. The second critical field is observed to increase with increases in dislocation density without any accompanying increase in the normal-state resistance. This change is used to calculate a parameter proportional to the phonon mean free path which modifies the coherence length in a manner similar to the electron mean free path. The magnitudes of this parameter are comparable to the average dislocation separations, suggesting that the coherence of the Cooper pairs is limited by scattering from dislocations. (auth)

26811 INFLUENCE OF MICROWAVE RADIATION ON CURRENT–VOLTAGE CHARACTERISTIC OF SUPERCONDUCTING

WEAK LINKS. Russer, P. (Technische Hochschule, Vienna). J. Appl. Phys.; 43: No. 4, 2008-10(Apr 1972).

The current–voltage characteristics of microwave-irradiated superconducting weak links have been calculated on the analog computer. Experimental results of several authors can be interpreted correctly by taking into consideration the resistive feedback. (auth)

26812 PREPARATION, MICROSTRUCTURE, AND HIGH-FIELD SUPERCONDUCTING PROPERTIES OF Nb_3Sn DOPED WITH GROUP-III, -IV, -V, AND -VI ELEMENTS. Enstrom, Ronald E.; Appert, John R. (RCA Labs., Princeton, N. J.). J. Appl. Phys.; 43: No. 4, 1915-23(Apr 1972).

The influence of incorporating elements from groups III, IV, V, and VI into vapor-deposited Nb_3Sn superconducting ribbon on the critical current density in magnetic fields up to 190 kOe was examined, and the mechanism of the enhancement of J_c by carbon-containing gases was investigated. It had been found previously that CO_2, CO, and N_2, but not O_2 or CH_4, are effective in increasing J_c. It is now established that the less stable C_2H_6 and C_3H_8 are as effective as CO_2, and that BCl_3 increases J_c to a lesser extent. However, H_2S, NH_3, and NO decrease J_c compared with an undoped Nb_3Sn sample. By optimizing the CO_2 concentration in the gas phase, the J_c increase can be as much as a factor of 5; this optimum concentration corresponds to about 2000 ppM carbon in the Nb_3Sn vapor-grown layer, as determined by radioactive tracer and mass spectrographic analyses. Since the solid solubility limit of carbon in Nb_3Sn is less than 200 ppM, carbon or carbide in excess of this amount is distributed as a second phase probably along subgrain or grain boundaries where it can effectively pin flux lines, and thereby increase J_c. From extrapolations of $J_c^{\frac{1}{2}}$ vs H, the upper critical fields at 4.2°K for undoped and BCl_3- and C_2H_6-doped Nb_3Sn on stainless-steel substrates are 184, 194, and 196 kOe, respectively, while for CO_2-doped Nb_3Sn on a Nb substrate it is 225 kOe. $\alpha = J_cH$ values ranging from 22 to 32×10^6 kOe A/cm^2 were attained for C_3H_8-, C_2H_6-, and CO_2-doped Nb_3Sn on stainless-steel samples and as high as 42×10^6 kOeA/cm^2 for CO_2-doped Nb_3Sn on Nb samples. For high- and medium-α materials, α is a function of the applied magnetic field; α/α_{max} vs H/H_{c2} is an approximately parabolic function with a maximum value at $H/H_{c2} = 0.4$ for high-α materials and $H/H_{c2} = 0.6$ for low-α materials. The latter value is in general agreement with theoretical predictions. (auth)

26813 STUDY OF THE DISTRIBUTION OF N_2 IN Ta AND V USING ROTATIONAL HYSTERESIS IN THE SUPERCONDUCTING MIXED STATE. Milne, I.; Gibbons, D. F. (Case Western Reserve Univ., Cleveland). J. Appl. Phys.; 43: No. 4, 1955-61(Apr 1972).

Rotational hysteresis curves of selectively oriented single crystals of tantalum and vanadium were determined in the mixed superconducting state at 2°K, as a function of nitrogen content. Enhanced flux pinning, which varied in magnitude with the nitrogen content, was observed when the magnetic field was parallel to the ⟨110⟩ directions in vanadium and the ⟨100⟩ directions in tantalum. These results are consistent with the hypothesis that the nitrogen forms clusters on specific crystallographic planes, determined by the respective elastic anisotropies of the solvent metal. (auth)

26814 ELECTRON–PHONON INTERACTIONS, d RESONANCES, AND SUPERCONDUCTIVITY IN TRANSITION METALS. Gaspari, G. D.; Gyorffy, B. L. (H. H. Wills Physics Lab., Bristol, Eng.). Phys. Rev. Lett.; 28: No. 13, 801-5(27 Mar 1972).

A simple theory is developed for calculating the electron–phonon coupling constant λ. (auth)

26815 ELECTRON–ELECTRON INTERACTION PARAMETER IN GOLD FILMS FROM THE PROXIMITY EFFECT. Gray, K. E. (Argonne National Lab., Ill.). Phys. Rev. Lett.; 28: No. 15, 959-61(10 Apr 1972).

McMillan's tunneling theory of the proximity effect was applied to results on gold/aluminum-oxide/aluminum thin-film sandwiches. Measurements of the transition temperature and minimum energy gap give consistent agreement with the theory and indicate that the interaction parameter in gold is 0.072×0.004. (auth)

26816 TRANSPORT EQUATIONS FOR MANY-BODY SYSTEMS BY METHODS OF THERMODYNAMIC GREEN'S FUNCTIONS. Pelka, David Gerard. Riverside, Calif.; Univ. of California (1971). 93p. University Microfilms Order No. 72-10,395.

Thesis.

The method of thermodynamic Green's functions is used to obtain the continuity equations for many-particle systems expressed in second-quantization formalism and, also, to study the nonequilibrium behavior of a superconductor in a slowly varying external field. The four-divergence of a generalized current is related to the Green's function formulation of the many-body problem. The relations obtained take the form of continuity equations, with an extra source term corresponding to the creation or annihilation of particles allowed by the second-quantization formalism. With the aid of these many-body continuity equations, a connection between the two types of conservation laws for Green's functions in the literature, the generalized Ward identity of quantum field theory and the conserving approximations of Baym and Kadanoff, is derived. To study the nonequilibrium behavior of a superconducting system, the exact transport equations for both the electron and phonon Green's functions are derived. Then following a procedure outlined by Kadanoff and Baym and assuming a slowly varying external perturbation, the exact transport equations can be cast into the form of a generalized Boltzmann transport equation for the system. The generalization comes about because the Boltzmann equations obtained include not only the dynamic effects of collisions, but also the kinetic effects of the external potential on the motion of the particles in between collisions—an effect that the ordinary Boltzmann equation neglects completely. Also, using the criteria of Baym's Φ-derivability, one obtains the conservation laws of number, momentum, and energy for the superconducting system. Further, explicit expressions for the momentum stress tensor, energy current, and mass current are derived. Finally, it is shown exactly how to go about solving these generalized Boltzmann transport equations. This is done by obtaining the solution to the electron Green's function equation of motion. (Diss. Abstr. Int., B)

26817 EFFECTS OF EXTERNAL RF RADIATION ON JOSEPHSON TUNNEL JUNCTIONS. Russo, Vito Francis. University Park, Pa.; Pennsylvania State Univ. (1971). 97p. University Microfilms Order No. 72-9521.

Thesis.

The effects of external rf radiation on the dc current–voltage characteristics of broad-area Josephson tunnel junctions were investigated. Current steps were observed in the I–V characteristics in the presence of RF radiation of angular frequency ω_R at dc potential differences, V_0, given by $V_0 = (N/L + 1)[(h\omega_R)/2e)]$, where e and h are the electronic charge and Planck's constant divided by 2π, respectively, and N and L are integers. The current steps at submultiples of N $[(h\omega_R/2e)]$ are due to alternating currents in the junction at frequencies that are harmonics of $\omega_0 = (2eV_0/h)$. The harmonic currents are explained by including in the Josephson equation $(\partial\phi/\partial t) = (2eV/h)$, where ϕ is the phase difference across the barrier and V is the total potential difference across the barrier, the self-induced RF potential difference across the oxide layer of the junction due to the feedback of Josephson radiation at the frequency $\omega_0 = (2eV_0/h)$. A mathematical theory was developed for the current steps at $V_0 = (N/L + 1)$ $[(h\omega_R/2e)]$ in the presence of RF radiation. This theory is an extension of a theory by Werthamer. The theory has been compared with experimental data. The theory is in agreement with the experimental data except that the ratio of the observed heights of the zero-voltage currents to the observed heights of current steps at finite voltage is only 25 to 50% of the calculated ratio. The broad-area Josephson tunnel junction has the characteristics of an electromagnetic oscillator "driven" by the alternating Josephson current at frequency $\omega_0 = (2eV_0/h)$. (Diss. Abstr. Int., B)

26818 CURRENT-VOLTAGE CHARACTERISTICS OF SUPERCONDUCTING POINT-CONTACTS. Puma F, Marcello. Charlottesville, Va.; Univ. of Virginia (1971). 121p. University Microfilms Order No. 72-7154.

Thesis.

Various kinds of structure appearing on the I–V characteristics of etched Nb–Nb point contacts are studied as a function of temperature. Features that follow $\Delta(T)$, the BCS gap temperature dependence, and features with a faster temperature dependence than $\Delta(T)$ are detected. All the features observed for these point contacts are interpreted in terms of self-absorption of the Josephson radiation. The features that follow a faster temperature dependence than $\Delta(T)$ are associated with a voltage V given by $V = m\phi_0\nu$ $[\phi_0 = (h/2e)]$ with $m > 1$ and having an almost continuous temperature dependence. An explanation of this temperature dependence is proposed in terms of the model used by Sullivan, et al. Temperature-independent features can be introduced on the I–V characteristics of point contacts by coupling the contact to a resonant absorber. The possibility of using a point contact as a spectrometer in the range 1 to 10^3 cm^{-1} is discussed. (Diss. Abstr. Int., B)

26819 MICROWAVE SURFACE RESISTANCE OF TYPE II SUPERCONDUCTORS IN THE VORTEX STATE. Pedersen, Robert James. Los Angeles; Univ. of Southern California; (1971). 91p. University Microfilms Order No. 72-6094.

Thesis.

Caroli and Maki have derived expressions from the microscopic theory of Type-II superconductors which relate resistive behavior in perpendicular magnetic fields to motion of the Abrik-

osov vortex structure. Recently, Thompson has included corrections to the Caroli–Maki dirty limit response function which results in a somewhat different resistive behavior. Calculations of Takayama and Ebisawa support Thompson's results but extensive dc measurements, with rather wide scatter, tend to support the Caroli–Maki theory. Microwave surface resistance measurements of various Nb–Ta and Pb–In superconducting alloys were made in order to test the two theories. Since the theories describe the discontinuity in slope of the resistance at the upper critical magnetic field, H_{c_2}, a derivative technique was employed to directly measure this slope. Although the change in slope near H_{c_2} is rather abrupt, it is found that the transition takes place in a range of 100 to 400 Oe with some additional thermal rounding. This transition width is probably due to slight sample in homogeneities. Since the slope generally increases prior to the transition, it is found that the derivative technique permits the extrapolation of the slope data to H_{c_2}. When this is done good agreement is found with the calculations of Thompson, Takayama, and Ebisawa for both the dirty limit, weakly coupled Nb–Ta alloys and the dirty limit, strong coupled Pb–In alloys. If the rising slope near H_{c_2} is ignored and the lower but more constant slope some distance from H_{c_2} is used in the calculations, good agreement with the theory of Caroli–Maki is found. Slope data determined from plots of resistance near H_{c_2} is likely to be weighted in favor of lower slopes and this could account for the fact that dc data tends to favor the Caroli–Maki calculations instead of the corrected theory of Thompson and Takayama–Ebisawa. Thompson has suggested, without proof, that his correction to the response function is short range and applies only near H_{c_2} while the Caroli–Maki terms are valid over a wider range of field. It may be concluded, consistent with the measurements, that both microscopic theories are essentially correct and that the additional terms of Thompson and Takayama–Ebisawa account for the changes in slope near H_{c_2}. (Diss. Abstr. Int., B)

26820 MAGNETIC FLUX QUANTIZATION IN MULTIPLY CONNECTED SUPERCONDUCTING CYLINDERS. Henry, Hugh Littell. Charlottesville, Va.; Univ. of Virginia (1971). 122p. University Microfilms Order No. 72-7122.

Thesis.

Single-valuedness of the superconducting wave function requires that magnetic flux must be trapped in quantized units for a thick, multiply connected superconductor cooled through its transition temperature in the presence of a magnetic field. Such quantized flux states were studied for two types of multiply-connected cylinders: a pair of concentric cylinders and a double loop with a superconducting path passing twice around a single hole. The flux states were determined by comparing the difference in the magnetization when the cylinders were normal and superconducting. The concentric cylinders were rapidly cycled between normal and superconducting using ac Joule heating, and the magnetization change was detected with a closely coupled pickup coil. For the double loop, a weakly linked niobium ring was employed as a magnetometer to measure the magnetization change as the cylinder was slowly heated and cooled between the normal and superconducting states. It was found that trapped flux is quantized in units of hc/4e, half the fluxoid quantum, in this case. A calculation of the Gibbs free energy of such systems was made using the macroscopic energy density equation, $f = H^2/8\pi$, applying as a constraint the condition of fluxoid quantization. The equilibrium magnetization followed directly from the thermodynamic relation, $M = df/dH$. The theoretical results correlated extremely well with the experimental data, indicating that straightforward application of the ideas of single-valuedness is all that is required to describe these systems. (Diss. Abstr. Int., B)

26821 INVESTIGATION OF THE DYNAMICS OF FLUX MOTION IN THE SUPERCONDUCTING SHEATH. Wagner, Jerome Francis. Athens, Ohio; Ohio Univ. (1971). 234p. University Microfilms Order No. 72-9597.

Thesis.

The dynamics of flux motion in the surface of a type-II superconductor in the sheath state, i.e., $H_c > H_{c_2}$, is investigated. Of particular interest is the response of the surface to small, low-frequency magnetic fields. The investigation was performed on the Pb–xIn alloy system where x = 1, 3, 5, 10 wt. %. The ac field technique was used as a probe of the surface and the waveforms of the response of the sheath to the ac stimulus were directly observed and recorded. Two models were considered when analyzing the flux motion. One model was based on the theory of flux creep, where the mechanism responsible for flux motion was thermal activation aided by a Lorentz-like force. The second model was based on the theory of flux flow in which flux motion was opposed by viscous and pinning forces. Both models are constructed on the underlying assumption that components of the external magnetic field enter normal to the surface in the form of quantized flux spots which are later pinned by defects in the surface. Since both mechanisms were likely to be present, a combination of the two was then considered. An equation describing flux motion was obtained from each model and each equation was computer-fitted to the data to obtain values for the adjustable parameters in the equation. Results led to the following conclusions: (a) The original surface critical-state models are not applicable since they consider ideal rather than real surfaces. (b) The observed waveforms suggest that a distribution of critical currents rather than a single critical current is present when the critical state is entered. (c) The angular dependence of the critical currents may be attributed to an over abundance of flux spots in the surface, whereby the overflow of flux spots are pinned by sites of weaker strengths which, in effect, limit the magnitudes of the critical currents. (d) The sensitivity of the critical currents to the frequency of the ac stimulus is a consequence of the viscous nature of the sheath. (e) The temperature dependence of the critical currents may be attributed to an increase in the free energy difference between the normal and superconducting states with decreasing temperature which results in an increase in the strengths of the pinning sites. (f) The large observed energy losses result from the motion of flux spots along the surface of the superconductor and, possibly, from fluctuations in the amplitude or phase of the superconducting order parameter. (TSS) (Diss. Abstr. Int., B)

26822 EFFECT OF ELECTROSTATIC CHARGING ON NORMAL-STATE CONDUCTIVITY AND SUPERCONDUCTING TRANSITION TEMPERATURE OF ALUMINUM. Williams, Robert Stephen. College Park, Md.; Univ. of Maryland (1971). 109p. University Microfilms Order No. 72-10,093.

Thesis.

Measurements were made of the effect of electrostatic charging (the "field effect") on the normal-state conductivity (the "normal field effect") and the superconducting transition temperature (the "superconducting field effect") of Al in the form of thin (30-300 Å) evaporated films. Addition of electrons was found to decrease the normal-state conductivity of annealed and unannealed Al films. Addition of electrons was found to increase the superconducting transition temperature in 4.2°K-deposited and annealed films. The effect of removing electrons was to produce a shift in the opposite direction. The effect of oxidation was studied in many of the films on which measurements of the superconducting field effect had been made. Oxidation was found to increase the transition temperature of all films evaporated from a tungsten wire filament. Some films evaporated from an aluminum-oxide crucible showed an increase in transition temperature with oxidation, others a decrease. The temperature width of the superconducting transition was consistent with previous work on Al films prepared under different conditions. The temperature dependence of film resistance above the transition temperature was consistent with previous work. (TSS) (Diss. Abstr. Int., B)

26823 DEPENDENCE OF THERMAL CONDUCTIVITY ON MAGNETIC FIELD DIRECTION IN SUPERCONDUCTING THIN FILMS. Moskowitz, Mitchell Seymour. New Brunswick, N. J.; Rutgers–The State Univ. (1971). 160p. University Microfilms Order No. 72-9653.

Thesis.

Measurements were made with the magnetic field aligned in the three principal orientations with the specimen: perpendicular to the plane of the specimen, and parallel to the plane of the specimen both parallel and perpendicular to the heat flow. The specimens ranged from thin films having thickness, d, less than the coherence length, ξ, to thick films having d greater than ξ. The impurity concentration was also varied to cover a range of electronic mean free path, l, from $l \ll d$ to $l > d$. A careful study of the anisotropy in the thermal conductivity was made with the field in the plane of thin ($d < \xi$) specimens. The conductivity with the field perpendicular to the heat flow in the specimen was observed to be always larger than when the field and heat flow are parallel. The magnitude of this anisotropic effect decreases with increasing electronic mean free path and decreasing film thickness. Measurements on thick ($d > \xi$) PbBi specimens indicate that when the field is parallel to the heat flow there is a contribution to the thermal conductivity due to the vortex cores. However, this contribution is only a small fraction of what would be expected if the vortex were described as a cylinder of radius ξ of normal metal. An increasing conduction through the vortex with decreasing electronic mean free path is also found. These results are consistent with theoretical studies of the excitations within the vortex. (Diss. Abstr. Int., B)

26824 MAGNETIC MEASUREMENTS OF STRONG-COUPLING $Pb_{1-x}Bi_xTl_x$ AND Pb–In SUPERCONDUCTING ALLOYS. Fearday, James Henry. Athens, Ohio; Ohio Univ. (1971). 113p. University Microfilms Order No. 72-9576.

Thesis.

An experimental study of the bulk critical temperature T_c, resistivity, and upper critical field H_{c2} near T_c was conducted on each of a series of $Pb_{1-2x}Bi_xTl_x$ and Pb–In alloys. In addition, dc magnetization measurements were conducted on the $Pb_{1-2x}Bi_xTl_x$ system over the temperature range from $0.2\,T_c$ to T_c. $Pb_{1-2x}Bi_xTl_x$ alloys for x = 0.015, 0.05, 0.10, and 0.20 and Pb–In alloys of 1, 3, 5, and 10 wt % In were studied. T_c and H_{c2} near T_c were measured for both sets of alloys using the ac susceptibility method. These measurements were compared with the recent strong-coupling calculations of Eilenberger and Ambegaokar and of Usadel. It is shown that Usadel's strong-coupling correction to the Ginzburg–Landau parameter κ for the $Pb_{1-2x}Bi_xTl_x$ system brings the calculated values of κ into good agreement with the values of κ which are determined from dc magnetization measurements. It is also shown that strong coupling is responsible, at least in part, for the discrepancy that existed between the previously measured and calculated values of κ in the Pb–In system. Eilenberger and Ambegaokar have made strong-coupling calculations of the slope of the critical field at the critical temperature, $(dH_{c2}/dT)_{T_c}$. The parameters needed to calculate this strong-coupling correction, along with the values of $(dH_{c2}/dT)_{T_c}$, are shown to agree to within experimental error with the measured values for the Pb–In alloy system. For the Pb–Bi–Tl system, agreement is also obtained provided that a reasonable assumption is made regarding the change in the value of $(dH_c/dT)_{T_c}$ with alloy composition. Before taking into account the effect of strong-coupling, the measured and calculated values disagreed by 15 to 20%. Any remaining deviation between experimental and calculated values is due to the correction factor not being large enough. This work also shows that strong coupling is probably not responsible for the disagreement between theory and experiment regarding the reduced parameter $\kappa_2(\rho,t)/\kappa_2(\rho,l)$ as calculated by Eilenberger. These strong-coupling alloys show the same type of disagreement for this parameter as is shown by many of the weak-coupling alloys. (TSS) (Diss. Abstr. Int., B)

26825 THERMAL CONDUCTIVITY OF SUPERCONDUCTING LEAD–INDIUM ALLOYS. Gupta, Ashok Kumar. Cleveland; Case Western Reserve Univ. (1971). 92p. University Microfilms Order No. 72-6298.

Thesis.

The thermal conductivity, K_m, of superconducting lead–indium alloys containing from 3 to 21 at. % In was measured in the mixed state as a function of temperature and magnetic field. The temperature dependence of thermal conductivities in the superconducting and normal states, K_s and K_n, respectively, were also measured in the range from 1.3 to 7.5°K. In the mixed state, the main emphasis was on the region near the upper critical field, H_{c2}, where Caroli and Cyrot found theoretically that the electronic thermal conductivity of dirty type-II superconductors varies linearly with applied magnetic field. They also showed that the ratio $[(dK_{em}/dH)/(dM/dH)]_{Hc_2}$ was a universal function of reduced temperature, where K_{em} is the electronic thermal conductivity in the mixed state and M is the magnetization. In order to compare with the Caroli–Cyrot theory, it was necessary to separate the lattice thermal conductivity. The field dependence of the lattice thermal conductivity was theoretically calculated by using the parameters found in the analysis of the temperature dependence of the lattice thermal conductivity in the normal and superconducting states and Maki's theory of ultrasonic attenuation. The experimental results begin to agree with the Caroli–Cyrot theory as one approaches the dirty limit. However, the lower-impurity-concentration alloys have a larger value of the ratio $[(dK_{em}/dH)/(dM/dH)]_{Hc_2}$ than predicted by the theory, and the disagreement increases with the decrease in indium concentration. (Diss. Abstr. Int., B)

26826 ULTRASONIC INVESTIGATION OF THE SUPERCONDUCTING PROPERTIES OF THE Nb–Mo SYSTEM. Lacy, Lewis L. Knoxville, Tenn.; Univ. of Tennessee (1971). 93p. University Microfilms Order No. 72-5459.

Thesis.

The superconducting properties of single crystals of Nb and two alloys of Nb and Mo were investigated by ultrasonic techniques. The results of measurements of the ultrasonic attenuation and velocities as a function of temperature, Mo composition, crystallographic direction, and ultrasonic frequency are reported. The attenuation and small velocity changes associated with the superconductivity of the samples are shown to be dependent on the sample resistivity ratio Γ, which varied from 4.3 for Nb–9% Mo to 6,500 for pure Nb. The ultrasonic attenuation data are analyzed in terms of the superconducting energy gap term $2\Delta(0)/kT_c$ of the BCS theory. A new model is proposed for the analysis of ultrasonic attenuation in pure superconductors with two partially decoupled energy bands. To analyze the attenuation in pure superconducting Nb, the existence of two energy gaps was assumed to be associated with the two partially decoupled energy bands. One of the gaps was found to have the normal BCS value of 3.4 and the other gap was found to have the anomalously large value of 10. No experimental evidence was found to suggest that the second energy gap had a different transition temperature. The interpretation of the results for the Nb–Mo alloys are shown to be complicated by the possible existence of a second superconducting phase in Nb–Mo alloys with a transition temperature T_{c2} of 0.35 of the transition temperature T_{c1} of the first phase. The elastic constants of Nb and Nb–Mo alloys are shown to be approximately independent of Mo composition to 9 at. % Mo. These results do not agree with the current microscopic theory of T_c for the transition elements. (Diss. Abstr. Int., B)

26827 PHONON SPECTRA OF DILUTE Pb–In ALLOYS BY ELECTRON TUNNELING. Sood, Brij Raj. Cleveland; Case Western Reserve Univ. (1971). 95p. University Microfilms Order No. 72-6337.

Thesis.

The technique of electron tunneling has been used to obtain the effective phonon spectra, $\alpha^2(w)\,F(w)$, and the parameters defining the superconductivity for dilute Pb–In alloys by solving the Eliashberg equations. These quantities were extracted from the measured energy gap of the alloy film and the measured normalized conductance of the thin-film tunneling junction of the form Al/Al_2O_3/Pb–In. All the measurements were made around 1°K at which temperature both the films were in the superconducting state. A band of frequencies, the so-called impurity band, appeared beyond the high-frequency cutoff of the phonon spectrum of pure Pb. The impurity band was found to consist of at least two peaks which were explained as being due to the vibrations of isolated indium atoms surrounded by the lead atoms and the vibrations of the pairs of indium atoms surrounded by the lead atoms. The position of the first peak remained constant and its width varied linearly with the concentration of indium. The position of the second peak remained constant up to 2 at. % of indium but varied at higher indium concentrations. The width of the second peak also varied linearly with indium concentration. A determination of the energy gap to the superconducting transition temperature ratio showed that the electron–phonon interaction remained constant for all the alloys studied. (Diss. Abstr. Int., B)

26828 THERMAL CONDUCTIVITY OF SUPERCONDUCTING NIOBIUM FROM 0.03 TO 4K. Smith, Stephen Caroll. Urbana, Ill.; Univ. of Illinois (1971). 104p. University Microfilms Order No. 72-7067.

Thesis.

The thermal conductivity in the superconducting state was measured from 0.03 to 4°K for four single-crystal niobium rods with residual resistivity ratios (R(300°K)/R(4.2°K)) of 26, 135, 196, and 1800, respectively. The dependence of the thermal conductivity on strain and surface condition was studied, and it was determined that the transport of thermal energy below 2°K is due principally to phonons. The presence of an extra phonon scattering mechanism near 2°K was demonstrated and was linked to the presence of dislocations in the crystal. The thermal conductivity near 1°K was examined for evidence of thermal transport or phonon scattering by electrons associated with a second energy gap. It was found that the number of the "second-gap electrons" in niobium is much smaller than has been reported previously, or that these electrons do not take part in the transport of heat in the superconducting state in niobium. (Diss. Abstr. Int., B)

26829 SUPERCONDUCTIVITY OF THORIUM HYDRIDES AND THORIUM DEUTERIDES. Toepke, Ival Lee. Urbana, Ill.; Univ. of Illinois (1971). 90p. University Microfilms Order No. 72-7090.

Thesis.

Superconductivity of thorium hydrides was tested and Th_4H_{15} found to be a superconductor with a transition temperature near 8°K. Measurements of the diamagnetic susceptibility of 24 thorium hydride and thorium deuteride samples of various compositions were made to determine the effect of composition and of hydrogen isotope on the superconducting transition temperature. The transition temperatures ranged from 6.8 to 8.4°K for samples with hydrogen compositions greater than the dihydrides, while the transition temperatures are less than 1.1°K for the dihydride and dideuteride samples. No hydrogen isotope effect was found outside the 5% uncertainty in transition temperature. The specific heat of Th_4H_{15} was measured in order to determine a jump in the heat capacity that is characteristic of bulk superconductivity. No discontinuous change in the specific heat was found, indicating that the transition temperature was smeared out or that the superconductivity is not characteristic of the bulk material. The effect of heat treatment was also studied. (Diss. Abstr. Int., B)

26830 RELATIONSHIP BETWEEN SUBSTRATE TEMPERATURE, STRUCTURE, AND SUPERCONDUCTING PROPERTIES

OF REACTIVELY SPUTTERED NIOBIUM NITRIDE THIN FILMS. Spitzer, Hermann J. (Army Mobility Equipment Research and Development Center, Ft. Belvoir, Va.). J. Vac. Sci. Technol.; 9: No. 1, 333-6(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

Niobium nitride thin films were reactively sputtered at substrate temperatures of 300 and 700°C. The background pressure was in the low 10^{-7}-torr range, total sputtering pressure was kept at 2×10^{-3} torr, and partial pressures of argon and nitrogen were monitored and controlled with a residual gas analyzer. The structure was examined by reflection electron diffraction, and $J_c - H$ characteristics were measured using a pulsed-field and pulsed-current technique. Substrate temperature and Ar/N_2 partial-pressure ratio strongly influenced the crystallographic structure, which in turn determined the superconducting properties of the films. Consequently, a clear relationship between deposition parameters, particular nitride phases and their mixtures, and superconducting properties was established. The highest T_c of 14.9°K has been observed for a film deposited at 700°C which exhibited the δ NbN phase. (auth)

26831 EFFECT OF SURFACE CHARGE ON THE SUPERCONDUCTING TRANSITION TEMPERATURE AND NORMAL-STATE CONDUCTIVITY OF DISORDERED METAL FILMS. Felsch, W.; Glover III, R. E. (Univ. of Maryland, College Park). J. Vac. Sci. Technol.; 9: No. 1, 337-40(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

Measurements were made of the shifts with added electrostatic charge of the normal-state residual conductivity and superconducting transition temperature of films of amorphous Bi and Ga, metastable crystalline Ga, and disordered crystalline Pb. For the amorphous Bi samples, adding electrons increased both the superconducting transition temperature T_c and the residual conductivity σ_0. For the other materials, adding electrons lowered both T_c and σ_0. In each case, removing electrons produced a shift of equal magnitude but of opposite sign to that observed for negative charging. For a given applied charge, the shifts in T_c and σ_0 were proportional to the reciprocal of the film thickness within the accuracy of the measurements. Results were reproducible from sample to sample. The correlation between the signs of the shifts T_c and σ_0 for the metals investigated was the reverse of that observed previously for Sn, In, and Tl. Measurements were also made of the effect of condensed oxygen on the superconducting transition temperature of the films. Physically adsorbed oxygen lowered T_c for all of the materials. Increasing the temperature to the point that a reaction between the metal and the condensed oxygen began produced a further reduction in T_c for Pb and metastable crystalline Ga. (auth)

26832 SUPERCONDUCTING PROPERTIES OF ANNEALED Nb-Al-Ge THIN FILMS. Janocko, M. A.; Gavaler, J. R.; Jones, C. K. (Westinghouse Research Labs., Pittsburgh). J. Vac. Sci. Technol.; 9: No. 1, 341-4(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

Annealed bulk Nb-Al-Ge possesses the highest superconducting transition temperature presently known ($T_c \sim 20$°K). A report is made on T_c and other superconducting properties of annealed Nb-Al-Ge thin films prepared by sputtering from a 3Nb · 0.8Al · 0.2Ge cathode. Annealing was performed in a high vacuum environment maintained at 10^{-6} torr or less, for times and temperatures near the optimum conditions for bulk Nb-Al-Ge. Films with T_c's from 12 to 16°K were annealed and in all cases a rise in T_c was observed, with the maximum value obtained thus far being 17.5°K. The current-carrying capacity (J_c) values, already substantially higher for unannealed thin films than for the bulk, were raised even further in the annealed samples, indicating that annealing has no detrimental effects on the flux pinning in these films. (auth)

26833 SUPERCONDUCTIVE CONDUCTOR. (to Compagnie Generale d'Electricite). British Patent 1,267,110. 15 Mar 1972. Priority date 26 Dec 1968, France.

The conductor described for carrying direct or alternating current contains a ribbon of pure metal, either refined aluminum or electrolytic copper, in which are buried longitudinally extending superconducting elements. The ribbon has one face covered with a thin layer of copper and the face of the thin copper not in contact with the ribbon is covered with a layer of superconducting material. (M.H.R.)

26834 SUPERCONDUCTIVE TUNNEL JUNCTION DEVICE. (to International Business Machines Corp.). British Patent 1,267,958. 22 Mar 1972. Priority date 28 Oct 1968, United States.

The device described includes: a superconducting tunnel junction formed by two superconducting strips overlapping each other by a common length, L, and a potential barrier layer interposed between the strips; a superconducting ground plane insulated from the junction; and means for applying a magnetic field to the junction, in which the length L is significantly greater than the penetration depth of the magnetic field into the barrier layer. The junction is such that the relationship between the maximum junction current and the magnetic field is asymmetric and has a portion wherein a large change in current occurs for a small change in field. (M.H.R.)

26835 NOISE IN A JOSEPHSON JUNCTION. Lee, Patrick A. (Yale Univ., New Haven); Scully, Marlan O. Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 213-17(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The problem of a Josephson junction interacting with a quantized electromagnetic field contained in a microwave cavity is considered. Inasmuch as the cavity has a quality factor Q and an external current J flows in and out of the junction, this is a problem in nonequilibrium statistical mechanics. Using a technique that eliminates adiabatically the radiation field directly from the total density matrix equation of motion, the spectrum of the voltage fluctuations from which the linewidth of the emitted radiation is obtained is calculated. As a consequence of this calculation, it is found that the current-voltage characteristic is slightly modified at finite temperatures. A physical argument for this effect is given and possible experimental observation of this effect is discussed. (auth)

Equipment and Devices

Refer also to abstracts 25688 and 26156.

PHYSICS (NUCLEAR)

26836 (AECL–4068) PHYSICS DIVISION PROGRESS REPORT, JULY 1–SEPTEMBER 30, 1971. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). 124p. (PR-P–91). Dep. NTIS (U. S. Sales Only). AECL $2.50.

Progress is reported by the Physics Division of Atomic Energy of Canada Limited for the period July 1 to September 30, 1971. Summaries of projects in the Nuclear Physics, General Physics, Neutron Physics, Theoretical Physics, and Mathematics and Computation Branches are provided. (E.M.T.)

Neutron Interactions with Matter

Refer also to abstracts 26174, 27039, 27117, 27118, 27256, 27257, 27295, and 27367.

26837 (AAEC/TM–606) NOTE ON THE ADLER–ADLER RESONANCE FORMALISM. Cook, J. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1971. 9p. Dep. NTIS (U. S. Sales Only).

Over restricted energy ranges, the Adler–Adler method of parameterizing resonance cross sections is in general the exact result of inverting the channel matrix. This provides a simple analytical form for the cross section which can be used in reactor physics calculations. (auth)

26838 (CONF-711125–5) EFFECTS OF SOURCE ASYMMETRY ON RADIATION TRANSPORT IN INFINITE AIR. McGregor, B. J. (Oak Ridge National Lab., Tenn.). [1971]. 19p. Dep. NTIS.

From Radiation Shielding Information Center seminar-workshop; Oak Ridge, Tenn. (15 Nov 1971).

MORSE, a general-purpose multigroup Monte Carlo code, was used assuming that source neutrons were born at the origin at time zero. Results are presented here for a 12.2- to 15-MeV neutron source and the air kerma response for both neutrons and gamma rays. (M.H.R.)

26839 (INP–776) INCOHERENT CROSS-SECTION FOR NEUTRON QUASIELASTIC SCATTERING IN A LIQUID CRYSTAL. Rosciszewski, Krzysztof (Institute of Nuclear Physics, Krakow (Poland)). 1971. 27p. Dep. NTIS (U. S. Sales Only).

The incoherent cross section for neutron quasielastic scattering in a liquid crystal is calculated. The cross section depends on the orientation of the momentum transfer vector with respect to the nematic axis. The models used correspond in the case of isotropy to the diffusion model of Vineyard and to the Singwi-Sjölander model developed by Larsson et al. (auth)

26840 (LA-DC–13268) TWO DIMENSIONAL AIR TRANSPORT FROM A POINT, ANISOTROPIC SOURCE. Lathrop, K. D. (Los Alamos Scientific Lab., N. Mex.). [1971]. 8p. (CONF-711125–4). Dep. NTIS.

From Radiation Shielding Information Center seminar-workshop; Oak Ridge, Tenn. (15 Nov 1971).

The calculation of the angular flux in air from a given anisotropic point source of neutrons is described. These calculations were performed with the TWOTRAN SPHERE code suitably modified to include an analytical calculation of the uncollided flux. The calculated total flux was spot checked for accuracy against results from a Monte Carlo calculation. (M.H.R.)

26841 DIFFRACTION METHOD FOR MAGNON STUDIES AT THE PULSED NEUTRON SOURCE. Dobrzynski, L.; Kepa, H. (Joint Inst. of Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods; 99: No. 2, 227-30(1972).

The diffraction technique for magnon studies at the pulsed neutron source is discussed. Particular attention is paid to the phonon scattering which may be disturbing in the magnon measurements. Some methods of avoiding such a scattering or extracting it from the total scattering are discussed. The illustrative results for the neutron scattering by spin waves in Co–Fe alloy are presented. (7 figures) (auth)

26842 PROBLEMS OF NEUTRON OPTICS. Frank, I. M. Vestn. Akad. Nauk SSSR; No. 12, 13-27(Dec 1971). (In Russian).

This brief review of neutron optics explained the scope of the subject and the divisions of the neutron spectrum into ultracold, cold, thermal, and resonance types, with further subdivisions of the ultracold and resonance. A comparison is made of neutron sources and an x ray tube. The time-of-flight method is discussed and the development of the method is considered. The pulsed fast reactor is described in some detail, and the small-scale plutonium rod assembly is illustrated which is capable of a million kW. (K.S.W.)

26843 ENERGY SELECTION BY PSEUDORANDOM MODULATION IN POLARIZED NEUTRON DIFFRACTION. Mezei, F.; Pellionisz, P. (Central Research Inst. of Physics, Budapest). Nucl. Instrum. Methods; 99: No. 3, 613-15(1972).

An experimental method for polarized-neutron diffraction studies is described which permits the separation and determination of higher-order reflections and inelastic magnetic scattering contributions by using a pseudostatistically controlled spin-flipper device. (3 figures) (auth)

26844 MONTE CARLO ANALYSIS OF NEUTRON-PRODUCED SINGLE EVENT SPECTRA. Oldenburg, U.; Booz, J. (EURATOM, Ispra, Italy). Biophysik; 8: No. 1, 71-80(30 Dec 1971).

It is shown how the shape of neutron-produced single event spectra for spherical cavities varies with sphere diameter and neutron energy. This variation is due to the changing contributions of the most frequently produced secondary particles to the different regions of the total single event spectrum. The latter is shown on the basis of single event spectra of protons, ^{12}C-, ^{14}N- and ^{16}O-recoils, which have been calculated using the Monte Carlo method. (auth)

26845 THERMAL NEUTRON ABSORPTION IN NEUTRON SOURCES AND CAVITY WALLS CENTERED IN MODERATING SOLUTIONS. De Volpi, A. (Argonne National Lab., Ill.). J. Nucl. Energy; 26: No. 2, 75-89(Feb 1972).

A direct assessment was obtained of cavity-wall and self-absorption correction factors for neutron sources placed in moderating solutions, such as the manganese bath. Cylindrical and spherical cavities were studied. Cadmium liners were placed within these cavities, and the decrease in apparent source emission rate was taken to be a measure of the thermal neutron flux incident on the cavity. Both dilute and concentrated solutions of manganese sulfate were used. Sb-Be (γ,n), Ra-Be (γ,n), ^{252}Cf, Ra-Be (α,n) and Am-Be (α,n) sources produced neutrons for the experiments. The probable absorption rate for the minimum cavity (walls of stainless-steel or aluminum) was deduced by an iteration procedure. Calculations, using a simple age-diffusion model, were made of the neutron flux distribution, and close estimates of the "black" cavity absorption were obtained through use of a single common normalization factor. The final absorption rates for the "grey" cavity walls and the source itself were obtained by further normalization to the experimental data. Several intermediate situations of fairly thick steel cavities were computed and the results agreed well with the experimental data. Various implications of this work are discussed. It is now reasonable to attribute errors of less than 0.1% to most thermal absorption correction factors needed for accurate determination of neutron source strengths by the manganese bath technique. (auth)

26846 EFFECT OF COLD NEUTRONS ON THE NEUTRON PULSE AND WAVE PROPAGATIONS IN CRYSTALLINE MEDIA. Takahashi, Akito (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 3, 172-84(Mar 1972).

Measurements of propagating pulse shapes in graphite and lead prisms were carried out with 300°K water-moderated and 77°K ice-moderated sources. Corresponding theoretical analyses were also performed, with use made of the successive iteration method, and a coupled two-group theory based on the distributed source diffusion equation was developed. It was established that: (a) infiltrating cold neutrons below Bragg cutoff energy, which has a sharply peaked pulse head, produce peculiarly shaped pulse propagation responses from detector; (b) the resonance phenomena observed in wave propagation can be fairly well explained as due to the interference between the thermal neutron group and the infiltrating cold neutron group, the cold neutrons in question being those below the Bragg cut-off energy in the case of graphite, and in the case of lead those below 0.01 eV; and (c) in the analyses related to resonance phenomena in graphite, the experimental characteristics are more consistently represented in the results of calculations using the BNL-325 data as compared to those using the UNCLE data for the total cross section below the Bragg cutoff. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstract 26891.

26847 (USC–113–P-24-1) ANNUAL PROGRESS REPORT OF THE U.S.C. NUCLEAR PHYSICS RESEARCH LABORATORY.

(University of Southern California, Los Angeles. Dept. of Physics). Aug 1971. Contract AT(04-3)-113. 89p. Dep. NTIS.

ARGON-40—proton reactions (p,He-3) and (p,α) at 45 MeV, energy spectra and angular distributions for, (E)
CALCIUM-40—proton reactions (p,He-3) and (p,α) at 45 MeV, energy spectra and angular distributions for, (E)
FLUORINE-19—proton reactions (p,pd), (p,pt), (p,pα), (p,2p), and (p,2d) with, energy spectra and angular correlations for, (E)
HELIUM-3—proton reactions (p,2p) and (p,pd) at 35 MeV, particle energy spectra from, (E)
—proton reactions (p,2p) and (p,pd) at 35 MeV, analysis of quasifree scattering in, (E)
—proton reactions at 35 MeV, two-particle coincidence study of four-body breakup in, (E)
NITROGEN-15—proton reactions (p,α), (p,He-3), and (p,t) at 45 MeV, energy spectra from, (E)
OXYGEN-16—proton reactions (p,2p) at 45 MeV, angular correlations for, (E)
SCANDIUM-45—proton reactions with, angular distributions and yields of helium and lithium isotopes from, (E)
(J.W.R.)

26848 ANGULAR DISTRIBUTIONS OF QUASI-FREE SCATTERING CONTRIBUTIONS IN DEUTERON BREAK-UP BY PROTONS AND DEUTERONS. Andrade, E.; Valkovic, V.; Rendic, D.; Phillips, G. C. (Rice Univ., Houston, Tex.). Nucl. Phys.; A183: No. 1, 145-60(1972).

Proton-proton and proton-neutron coincidence spectra from the p + d → p + p + n reaction were measured simultaneously for E_p = 12.5 MeV and $\theta = \theta_1 = -\theta_2$ in the interval $15° \leqq \theta \leqq 60°$. Deuteron-proton and deuteron-neutron coincidence spectra from the d + d → d + p + n reaction were measured also for E_d = 12.5 MeV and $\theta = \theta_1 = -\theta_2$ in the interval $15° \leqq \theta \leqq 40°$. Measured spectra are discussed in terms of the quasi-free scattering model. The shape of measured spectra and the angular dependence of the peak cross sections are fairly well reproduced. It was found that the ratio of the peak cross section for n-p and p-p quasi-free scattering in the p + d → p + p + n reaction varied from 1.3 at $\theta = 15°$ to 4.3 at $\theta = 42.5°$. The ratio of the peak cross section for n-d and p-d quasi-free scattering in the d + d → d + p + n reaction was found to be constant and close to one. The variation of the σ_{np}/σ_{pp} peak ratio in the p + d → p + p + n reaction can be attributed to the influence of n-p and p-p final-state interactions. (auth)

26849 HYDROGEN AND DEUTERIUM TOTAL NEUTRON CROSS SECTIONS IN THE MeV REGION. Clement, J. M.; Stoler, P.; Goulding, C. A.; Fairchild, R. W. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-1)-328. Nucl. Phys.; A183: No. 1, 51-9(1972).

Total neutron cross sections, using a continuous-energy source of neutrons, were measured for hydrogen and deuterium. The neutron energy range covered was from less than 1 MeV, to about 30 MeV. No structure is observed for either isotope. The precision of the cross-section magnitudes appears to be within 1% over much of the measured energy interval. (auth)

26850 REACTION CROSS SECTIONS FOR PROTONS IN THE ENERGY RANGE 220 TO 570 MeV. Renberg, P. U. (CERN, Geneva); Measday, D. F.; Pepin, M.; (and others). Nucl. Phys.; A183: No. 1, 81-104(1972).

Proton reaction cross sections have been measured for targets of natural isotopic abundance of the following elements and compounds: H, Be, C, Al, Fe, Cu, Ge, Sn, Pb, H_2O, B_4C and NaI. Data for proton energies between 220 and 570 MeV have been obtained with two types of transmission-counter assembly. The total errors are of the order of ±3%, which is a factor of three better than existing measurements in this energy region. A slight increase of the reaction cross sections with energy is observed for most of the elements studied. The results interpreted in terms of the semi-classical theory of reaction cross section as function of energy clearly demonstrate the onset of pion-production above 250 MeV. (auth)

26851 THREE-BODY BREAK-UP IN THE d + d → d + p + n REACTION. Valkovic, V.; Duck, I.; Sweeney, W. E.; Phillips, G. C. (Rice Univ., Houston, Tex.). Nucl. Phys.; A183: No. 1, 126-44(1972).

Neutron-charged-particle and charged-particle-charged-particle coincidence spectra from the d + d → d + p + n reaction were measured for $\theta_1 = -\theta_2 = 20°$ at bombarding energies 6–13 MeV. Deuteron-neutron and deuteron-proton spectra for $\theta_1 = -\theta_2$ are dominated by a broad peak associated with deuteron-nucleon quasi-free scattering. The measured data were interpreted using the quasi-free scattering model. The constructed model describes the general behavior of the coincidence spectra rather well, although the calculated spectral shapes are broader than the measured ones. The limitations of the simple quasi-free scattering model are shown also by the fact that the model predicts an order of magnitude to high cross section and that the normalization constant to the measured peak cross section is energy dependent. (auth)

26852 CROSS SECTIONS FOR $^2H(^3He,^3He)$ AND $^2H(^3He,^4He)$ AT 7 TO 18 MeV CENTRE-OF-MASS ENERGY. King, T. R.; Smythe, Rodman (Univ. of Colorado, Boulder). Nucl. Phys.; A183: No. 3, 657-65(1972).

Differential cross section angular distributions for $^3He + ^2H$ elastic scattering and for the $^2H(^3He, ^4He)^1H$ reaction have been measured at many energies between 7 and 18 MeV cm energy. A search for evidence of excited states of the compound nucleus, ^5Li, was made by observing the excitation functions for these processes. No evidence of ^5Li excited states was found. The region searched corresponds to ^5Li excitation energies of 23 to 34 MeV. (auth)

26853 DETERMINATION OF THE NEUTRON–NEUTRON SCATTERING LENGTH FROM A KINEMATICALLY COMPLETE EXPERIMENT WITH THE REACTION $^3H(t,n^4He)n$. Kuehn, B.; Kumpf, H.; Parzhitskii, S.; Tesch, S. (Joint Inst. for Nuclear Research, Dubna), USSR). Nucl. Phys.; A183: No. 3, 640-50 (1972).

In a two-dimensional measurement the energies of the α-particle and one neutron from the reaction $^3H(t, ^4He)$ have been analyzed. The angles have been chosen so as to observe the n-n final-state interaction near zero relative energy of the two neutrons. From a comparison of the data with the Born approximation a value $a_{nn} = -15.0 \pm 1.0$ fm for the $^1S_0$ scattering length has been obtained. Analogous experiments with the mirror reaction $^3He(^3He, p^4He)$ and with $^3He(t, p^4He)$ yielded $a_{pp} = -7.6 \pm 0.6$ fm and $a^s_{np} = -21 \pm 3$ fm for the singlet scattering lengths. Their agreement with known values demonstrates the possibility of obtaining a reliable value of a_{nn}. (auth)

26854 BREMSSTRAHLUNG IN p–α and d–p SCATTERING. Green, A. M.; Prodon, A. (Laboratorium fuer Kernphysik, Zurich). Nucl. Phys.; A183: No. 2, 225-39(1972).

Bremsstrahlung from p–α scattering is calculated for proton energies ranging from 6 MeV to 20 MeV and with the geometry $\theta_p = 70°$ and $\theta_\alpha = 30°$. The agreement with experiment is good, when the effect of the ^5Li(g.s.) resonance in the p–α system is included by the model of Feshbach and Yennie. The bremsstrahlung from d–p scattering is also calculated but using a simplified version of this model. A discussion of the form of the non-coplanarity is made for the p–α and p–p bremsstrahlung processes. (auth)

26855 RATIO OF THE $^4He(\gamma,p)$ AND $^4He(\gamma,n)$ CROSS SECTIONS. Dodge, W. R.; Murphy, II. J. J. (National Bureau of Standards, Washington, D. C.). Phys. Rev. Lett.; 28: No. 13, 839-43(27 Mar 1972).

The $^4He(\gamma,p)^3H$ and $^4He(\gamma,n)^3He$ cross sections were determined with a magnetic spectrometer in the energy interval of 30.0 to 51.8 MeV. The average value of $\sigma(\gamma,p)/\sigma(\gamma,n)$ was found to be 1.03 ± 0.04 in the above energy interval. The $^4He(\gamma,p)$ cross section decreases from 1.52 ± 0.13 mb at 31.7 MeV to 0.36 ± 0.03 mb at 51.8 MeV. (auth)

26856 EXACT CALCULATIONS OF NUCLEON–DEUTERON SCATTERING WITH INTERNUCLEAR FORCES INCLUDING A TENSOR COMPONENT. Avishai, Y. (Argonne National Lab., Ill.); Rinat, A. S. Phys. Lett.; 37B: No. 5, 487-90(27 Dec 1971).

The Fadde'ev–Mitra–Amado–Lovelace equations were solved with a separable tensor component added to a rank one triplet nucleon–nucleon interaction. Cross sections and nucleon polarizations for elastic nucleon–deuteron scattering were computed for 31 MeV > E > 7.8 MeV. For lower energies both functions agree reasonably well with experiment for a D-wave contribution, P_D, equal to 4 to 5%. Discrepancies grow with increasing energies. (auth)

26857 COULOMB ENERGY OF ^3He DEDUCED BY SYMMETRY RELATIONS FROM THE CHARGE FORM FACTORS. Fabre de la Ripelle, M. (Inst. of Nuclear Physics, Orsay, France). Fizika (Zagreb); 4: No. 1, 1-11(Jan 1972).

In the framework of the hyperspherical formalism a relation, independent of the shape of the trinucleon wave function, giving the Coulomb energy of ^3He in terms of the charge form factors of the nucleon, ^3He, and tritium was obtained. The utilization of the experimental data leads to an energy of about 0.67 MeV, smaller than the 0.76 MeV experimental value. This result may be interpreted as a proof of a small charge asymmetry of nuclear forces. (auth)

26858 NEUTRON–DEUTERON SCATTERING WITH LOCAL POTENTIALS. Kloet, W. M.; Tjon, J. A. (Univ. of Utrecht). Phys. Lett.; 37B: No. 5, 460-2(27 Dec 1971).

Pade technique is applied to the multiple scattering series of elastic n–d scattering above breakup threshold, using local two-particle interactions. As an example, the phase parameters and differential cross section are calculated at 14.1 MeV. (auth)

26859 PERTURBATION TREATMENT OF THE INTERACTION BETWEEN SINGLE-PARTICLE AND COLLECTIVE DEGREES OF FREEDOM. Dussel, G. G. (CNEA Ciclotron, Buenos Aires); Liotta, R. J. Phys. Lett.; 37B: No. 5, 477-9(27 Dec 1971).

The formalism of Brueckner and Levinson is applied to systems of interacting single-particle and collective degrees of freedom. It is shown how to evaluate the diagrams that contribute to the perturbation expansion, at any order, and it is pointed out which diagrams have to be taken into account in the formalism. (auth)

26860 TRANSMISSION REACTION FOR ONE AND TWO NUCLEONS BY LIGHT NUCLEI. Mil'yanich, D.; Tomash, P.; Furich, M.; Valkovich, V. (Boshkovicha Inst., Zagreb). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 739-46(Apr 1971). (In Russian).

A number of (n,d) and (n,t) reactions on light nuclei were studied, in which the neutron energy was generally 14 MeV. The angular distribution of deuterons was determined for the (n,d) reactions: $^{3}He(n,d)^{2}H$, $^{19}F(n,d)^{18}O$, $^{6}Li(n,d)^{5}He$, $^{10}B(n,d)^{9}Be$, and $^{14}N(n,d)^{12}C$; and for the (n,t) reactions: $^{10}B(n,t)^{8}Be$, and $^{14}N(n,t)^{12}C$. (K.S.W.)

26861 SEARCH FOR HIGH-LYING LEVELS IN THE MASS A = 5 NUCLEI. Baker, M. P.; Cameron, J. M.; Chant, N. S.; Mangelson, N. F. (Univ. of Washington, Seattle). Nucl. Phys.; A184: No. 1, 97-104(1972).

The reactions $^{7}Li(d,\alpha)^{5}He$ and $^{6}Li(^{3}He,\alpha)^{5}Li$ were studied at 24 MeV and 25.5 MeV, respectively, in a search for highly excited levels in the A = 5 nuclei. In addition to ground-state groups and well-known excited states in the vicinity of 16.6 MeV excitation, evidence was obtained from the $^{7}Li(d,\alpha)^{5}He$ reaction for broad energy levels at approximately 20.2 and 23.8 MeV excitation and from the $^{6}Li(^{3}He,\alpha)^{5}Li$ reaction for broad levels at approximately 19.8 and 22.7 MeV excitation. Excitation functions for the reactions $^{3}He(d,d)^{3}He$ and $^{3}He(d,\alpha)^{1}H$ were obtained at several angles for deuteron energies between 9.4 and 17.8 MeV. There is no clear evidence of resonances corresponding to states in ^{5}Li. (7 figures) (auth)

26862 GENERATOR COORDINATE METHOD APPLIED TO PAIRING VIBRATIONS. Siegal, C. D.; Sorensen, R. A. (Carnegie-Mellon Univ., Pittsburgh). Nucl. Phys.; A184: No. 1, 81-96(1972).

The generator-coordinate integral equation is solved for the pairing Hamiltonian with the gap parameter, Δ, as the generator coordinate. This is shown to be a poor approximation in the weak-pairing limit, so an improved wave function is used. Applications are made to the pairing vibrational spectra and two-nucleon transition strengths in $^{206,208,210}Pb$ and the single-particle levels in $^{207,209}Pb$. (auth)

26863 PHASE-SHIFT ANALYSIS OF d–α ELASTIC SCATTERING. Schmelzbach, P. A.; Grueebler, W.; Koenig, V.; Marmier, P. (Technische Hochschule, Zurich). Nucl. Phys.; A184: No. 1, 193-213(1972).

Phase shifts of angular momenta $l \leq 3$ for d–α elastic scattering were extracted from differential cross sections and the vector and tensor analyzing powers of the $^{4}He(\vec{d},d)^{4}He$ scattering between 3 and 11.5 MeV. Good fits to all the experimental data analyzed could be obtained; and the total reaction cross section, correctly predicted. Continuous extension of the phase shifts to lower and higher energies is possible, and the p-wave phase shifts are well fixed by the data analyzed. Single-level parameters of the 2^{+} and 1^{+} (T = 0) resonances were determined. The coupling between the s and d waves for J = 1 was found to be very small. No alternative solution could be found from the data used in this analysis. (auth)

26864 BINDING ENERGY CALCULATION OF TRITON WITH WITH FADDEEV EQUATION IN SEPARABLE APPROXIMATION. Purkayastha, Gita; Banerjee, S. N.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys.; 44: No. 8, 425-30(Aug 1970).

The binding energy of the triton was calculated using the Faddeev equation as formulated by Lovelace. Three sets of values were taken for the parameters occurring in the separable two-body nonlocal potential with one term only. (3 figures, 1 table) (auth)

26865 THEORETICAL ANALYSIS OF THE d(p,2p)n REACTION BY A POLAR GRAPH. Mithra, B.; Laverriere, R. (Univ., Lyon). Nucl. Phys.; A184: No. 1, 321-9(1972).

In the scheme of the dispersion approach to nuclear reactions with Feynman graphs, the reaction d(p,2p)n is studied at low energy by using a polar graph. For the energy dependence of the scattering peak and for the normalization factor, the results of the calculations are in good agreement with the experimental data. (auth)

26866 SOME ATOMIC EFFECTS IN THE TRITIUM β-SPECTRUM. Bergkvist, K.-E. (Forskningsinstitutet fuer Atomfysik, Stockholm). Phys. Scr.; 4: No. 1-2, 23-31(1971).

This work forms part of a detailed investigation of the upper end-point region of the tritium β-spectrum, aiming at improved information on neutrino mass, neutrino degeneracy and on the ft-value of the tritium β-decay. By the application of high-efficient β-spectroscopic methods a considerable improvement in basic accuracy of data has been achieved. The β-decay of an atom leads to a distribution in atomic final states; the present work is essentially concerned with the various quantitative consequences of this circumstance for the case of the tritium decay. The distribution in atomic final states is found to imply a mean square energy spread as large as $(27\ eV)^2$ in the end-point energy of the spectrum from the tritium atom. This inherent spread in end-point energy is comparable in magnitude with the experimental resolution width now reached in the investigation of the tritium β-spectrum and has to be considered when interpreting the experimental data with respect to limits on neutrino mass and neutrino degeneracy. The spread in end-point energy found will present a severe inherent difficulty in any effort to improve further the experimental information on these two entities. (auth) (Sweden)

26867 TWO-BODY PHOTODISINTEGRATION OF ^{3}He WITH LINEARLY POLARIZED GAMMA-RAYS. Fabbri, F. L.; Picozza, P.; Schaerf, C. (CNEN, Frascati, Italy). Lett. Nuovo Cim.; 3: No. 2, 63-5(8 Jan 1972).

The asymmetry parameter for the reaction $\gamma + {}^{3}He \rightarrow p + d$ was measured at 180 to 300 MeV using a linearly polarized bremsstrahlung beam. The detectors consisted of two plastic scintillators and a NaI crystal for the deuteron channel and a proton telescope with four plastic scintillators with aluminum absorbers for the proton channel. (J.W.R.)

26868 SEARCH FOR SPIN DEPENDENT EFFECTS IN THE THREE BODY FINAL STATE FROM THE $^{2}H(d,n)pd$ REACTION AT 11.3 MeV INCIDENT DEUTERON ENERGY. Pope, C.; Buget, N.; Blyth, C. O.; Dunscombe, P. B.; McKee, J. S. C. (Univ. of Birmingham, Eng.). J. Phys., A (London); 5: No. 3, L33-7(Mar 1972).

Cross sections and asymmetries were measured for the reaction $^{2}H(d,n)pd$. Approximate fits to the cross sections were made using a final state p–d interaction in the Watson–Migdal model. (auth)

26869 MEASUREMENT OF THE ANALYSING POWERS iT_{11}, T_{20}, T_{21}, AND T_{22} IN d-^{3}He ELASTIC SCATTERING. Koenig, V.; Gruebler, W.; White, R. E.; Schmelzbach, P. A.; Marmier, P. (Eidgenoessische Technische Hochschule, Zurich). Nucl. Phys.; A185: No. 1, 263-7(1972).

The analyzing powers $iT_{11}(\theta)$, $T_{20}(\theta)$, $T_{21}(\theta)$ and $T_{22}(\theta)$ of the elastic scattering of polarized deuterons on ^{3}He have been measured for six energies between 4.0 MeV and 11.5 MeV at c.m. angles between 30° and 160°. Strong variations of the angular distribution for all components are observed between 4.0 and 6.0 MeV which suggest that one or several levels in ^{5}Li are excited by this reaction. At higher energies the analyzing powers show strong similarities in the shape of the angular distribution to the d-^{4}He elastic scattering. (auth)

26870 QUASIFREE SCATTERING EFFECTS IN $^{2}H(p,pn)p$ AND $^{2}H(p,pp)n$ REACTIONS. Cahill, R. T. (Univ. of New South Wales, Kensington, Australia). Nucl. Phys.; A185: No. 1, 236-40(1972).

Recent kinematically complete $^{2}H(p,pn)p$ and $^{2}H(p,pp)n$ experiments have yielded the result that the p-n quasifree scattering cross section in the (p,pn) reaction is much larger than the corresponding p-p quasifree scattering cross section in the (p,pp) reaction. It is shown that as a consequence of the Pauli exclusion principle such a result is expected, but that a dynamical model is required to predict the ratio of the cross sections. Using a spin-dependent separable-potential Faddeev model, good quantitative agreement with the experimental results is obtained. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 26464, 26847, 26850, 26860, 26861, 26910, 26994, 26996, and 27070.

26871 (ANU-P-510) $^{12}C(d,n_0)^{13}N$ REACTION FROM 3.6 MeV TO 12.0 MeV. Davis, J. R.; Din, G. U. (Australian National Univ., Canberra. Research School of Physical Sciences). [1971]. 17p. Dep. NTIS (U. S. Sales Only).

The excitation function for the reaction $^{12}C(d,n_0)^{13}N$ was measured at 0° at 3.6- to 12.0-MeV deuteron bombarding energy. Angular distributions were measured at 7.0, 8.0, 9.0, 10.5, and

12.0 MeV. Cross sections are compared with the $^{12}C(d,p_0)^{13}C$ reaction. The yield curves for the neutron and proton groups show a strong similarity in shape. Different sets of deuteron and proton optical model parameters were used in fitting the 8-MeV energy averaged angular distribution. (auth)

26872 (BMBW-FBK-71-19) INVESTIGATIONS CONCERNING THE MICROSCOPIC THEORY OF DIRECT NUCLEAR REACTIONS USING THE $^6Li(p,^3He)$ α- REACTION AS EXAMPLE. Hub, R. (Tuebingen Univ. (West Germany). Institut fuer Theoretische Physik). Dec 1971. 93p. (In German). Dep. NTIS (U.S. Sales Only).

Starting from a microscopical theory the importance of exchange effects on direct nuclear reactions is studied using the $^6Li(p,^3He)$ α-reaction as an example. The various reaction mechanisms proposed in the framework of the direct reaction theory are simulated in this microscopical theory by neglecting certain exchange terms. The limits of the direct reaction theory are investigated by comparing the results of the simulated calculations with the calculations, where the wave functions are completely antisymmetrized. (auth)

26873 (RLO-1388-161) SUBSTATE EXCITATION OF 2^+ STATES PRODUCED BY INELASTIC SCATTERING OF PROTONS ON ^{12}C, ^{54}Fe, AND ^{58}Ni. Tesmer, J. R.; Schmidt, F. H. (Washington Univ., Seattle. Dept. of Physics). [1971]. 35p. Dep. NTIS.

A combined analysis of absolute in-plane and z-axis (spin-flip) p-γ angular correlation measurements for $0^+-2^+-0^+$ transitions leads to various combinations of substate cross sections, populations, and phase angles. These quantities are compared with predictions based on reaction mechanism theories. The test is very stringent. Measurements and analyses were carried out for $^{12}C(p,p'\gamma)^{12*}C$ (4.44 MeV) and $^{58}Ni(p,p'\gamma)^{58*}Ni$ (1.45 MeV) at E_p = 20 MeV, and for $^{54}Fe(p,p'\gamma)^{54*}Fe$ (1.41 MeV) at E_p = 19.6 MeV. Each of the three nuclei studied exhibit the following qualitative features: (1) The total inelastic cross sections have a less pronounced structure than do the individual substate cross sections. (2) The M = 0 cross section is the most diffractionlike; the oscillations are out-of-phase with respect to the oscillations of the elastic cross section. (3) The sum of the M = +2 and M = −2 cross sections also are diffractionlike, but are not in phase with the M = 0. Detailed comparisons with collective model distorted-wave Born approximation predictions are, on the whole, quite good for ^{58}Ni and ^{54}Fe, especially when the full-Thomas form for the spin-dependent perturbation potential is used. The isotropic term in the in-plane angular correlation function is particularly sensitive to the form and strength of the spin-orbit coupling potential. For ^{54}Fe the predictions are further improved when the strength of the spin-dependent perturbation potential is increased by setting the spin-dependent deformation equal to twice the central potential deformation. (auth)

26874 (RLO-1925-44) $^{12}C(d,n_0)^{13}N$ REACTION TO E_d = 4 MeV. Lefevre, H. W.; Burke, C. A.; Bahnsen, R. M. (Oregon Univ., Eugene). [1970]. Contract AT(45-1)-1925. 41p. Dep. NTIS.

$^{12}C(d,n_0)^{13}N$ differential cross sections in 20 keV steps to 4 MeV and in 10° steps to 160° are extracted from thick-target neutron spectra. The total cross section obtained from the A_0 term of a least squares Legendre fit to the data is systematically above the ORNL precision results by an amount varying from 19% at 1.2 MeV to 6% at 2 MeV and above. A renormalization of the present results is suggested. (6 figures, 2 tables) (auth)

26875 (p,p') REACTION ON THE ^{13}C NUCLEUS. Vasil'ev, S. S.; Galakhmatova, B. S.; Dem'yanova, A. S.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1693-4(Aug 1971). (In Russian).

The angular distribution of inelastic proton scattering by a ^{13}C target was studied at the excitation level of $\frac{1}{2}^+$, 3.08 MeV. Measurements were made with 6.36 and 6.48 MeV incident protons over the angular interval 20 to 150°. A multidimensional method of separating the particles was employed. The form of the experimental angular distribution agrees with the curve calculated from the tetragonal diagram. (tr-auth)

26876 REACTIONS $^9Be(^6Li,d)^{12}C$ AND $^9Be(^7Li,t)^{13}C$. Gol'dberg, V. Z.; Davydov, V. V.; Ogloblin, A. A.; Sakuta, S. B.; Chuev, V. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1663-5(Aug 1971). (In Russian).

The angular distribution of deuterons was determined for the reaction $^9Be(^6Li,d)^{13}C$ with 23.8 MeV ^6Li ions. The deuteron and triton spectra were measured for the $(^6Li,d)$ and $(^7Li,t)$ reactions (using 30.3 MeV ^7Li ions). The α-particle levels in ^{12}C and in ^{13}C are compared. (K.S.W.)

26877 INTERACTION OF POLARIZED DEUTERONS WITH THE NUCLEI ^{12}C, ^{19}F, AND ^{40}Ca. Boroviev, V. I.; Klyucharev, A. P.; Slabospitskii, R. P.; Andreev, G. B.; Lopatko, I. D. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1670-5(Aug 1971). (In Russian).

The elastic scattering of polarized deuterons by the nuclei ^{12}C, ^{19}F, and ^{40}Ca was investigated. Measurements were conducted at scattering angles Θ_{lab} = 70 and 90° and in the energy range E_d = 1.6 to 3.0 MeV. (tr-auth)

26878 SPECTROSCOPY OF ^{15}O BY USE OF THE $^{13}C(^3He,n)^{15}O$ REACTION. Georgopulos, P. D.; Lochstet, W. A.; Bleuler, E. (Pennsylvania State Univ., University Park). Nucl. Phys.; A183: No. 3, 625-39(1972).

Coefficients of fractional parentage (2-c.f.p.) were extracted from theoretical calculations for the $^{13}C(^3He, n)^{15}O$ reaction. These 2-c.f.p. were used in DWBA calculations to obtain the direct reaction part of the cross section. Angular distributions were taken for the $^{13}C(^3He, n)^{15}O$ reaction at 6 MeV, and fitted with an incoherent sum of direct and compound parts. One-particle-two-hole strengths were suggested for the first six positive-parity states. The positive-parity 10.28 MeV state is suggested to have a spin of $\frac{5}{2}$ or greater. (auth)

26879 RESONANCE STRUCTURE OF THE CROSS SECTION OF THE REACTION $^{11}B(\gamma,p)^{10}Be$. Dubovoi, E. I.; Nadtochii, V. G. Izv. Akad, Nauk SSSR, Ser. Fiz.; 35: No. 8, 1744-6(Aug 1971). (In Russian).

A Feynman diagram was drawn for the reaction $^{11}B(\gamma,p)^{10}Be$ as an aid to the elucidation of the fine structure of the resonance. The extremum spectra for the (γ,p) and (γ,n) reactions on ^{11}B are diagrammed for comparison and discussion. (K.S.W.)

26880 TRUNCATION EFFECTS IN ELASTIC SCATTERING BY A NUCLEAR HARTREE-FOCK FIELD. Jeukenne, J. P. (Univ., Liege); Lejeune, A. Nucl. Phys.; A183: No. 3, 666-72(1972).

The effects on the scattering states of the Hartree-Fock field, arising from truncation of the harmonic oscillator basis are analyzed. It is shown that certain scattering properties may be improved by using only the wave functions from the HF calculation. (auth)

26881 NEW APPROACH TO ON-LINE MASS ANALYSIS. Jungclas, H.; Macfarlane, R. D.; Fares, Y. (Texas A and M Univ., College Station). Radiochim. Acta; 16: No. 3-4, 141-7(Dec 1971).

A system has been developed which can be used to simultaneously identify the mass and measure the nuclear radiation of a short-lived radioactive isotope. The system combines the helium jet recoil transport method with the electrostatic particle guide technique to measure coincident decay recoil spectra by the time-of-flight technique. Results have been obtained for the β-delayed α-emitters, ^8Li and ^{20}Na. (auth)

26882 ISOSPIN AND SPIN-ISOSPIN DIPOLE OSCILLATIONS IN ^{12}C. Suzuki, T.; Hinohara, C. (Tohoku Univ., Sendai). Lett. Nuovo Cim.; 3: No. 11, 449-53(11 Mar 1972).

A deformed shell model is used to calculate the energies of ^{12}C resonance states and the form factors for their electroexcitation. The longitudinal form factor is due to the isospin dipole oscillation while the transverse form factor is due principally to the spin-isospin dipole oscillation. The results are compared with experimental data. (J.W.R.)

26883 REACTIONS INDUCED BY 30 MeV α-PARTICLES ON ^7Li. Merchez, F.; Arvieux, J.; Honda, T.; Morita, S. (Univ., Grenoble, France). Nucl. Phys.; A183: No. 2, 417-38(1972).

A ^7Li target was bombarded with α-particles of 30 MeV. Angular distributions of emitted protons, deuterons and tritons were measured simultaneously. The results are analyzed in terms of DWBA and PWBAE theories. Better fits are obtained for PWBAE calculations. Validity of a DWBA theory is discussed and cluster reduced widths concerned are deduced. (auth)

26884 COLLECTIVE CORRELATIONS IN THE GIANT DIPOLE CONTINUUM OF ^{12}C. Mshelia, E. D.; Barrett, R. F.; Greiner, W. (Univ., Frankfurt am Main). Phys. Rev. Lett.; 28: No. 13, 847-50(27 Mar 1972).

A continuum shell-model calculation based on the collective correlation model was made for the giant resonance of ^{12}C by using the eigenchannel reaction theory. The low-lying negative-parity states of ^{11}C and ^{11}B were taken into account by core-hole coupling. Partial, total, and integrated photoabsorption cross sections are calculated for the region of the giant dipole resonance. (auth)

26885 SPECTROSCOPIC DETERMINATIONS FROM RESONANCE SPIN-FLIP. Bernstein, E. M.; Ramirez, J. J.; Shamu,

R. E.; Cheng, Pui-wah; Soga, M. (Western Michigan Univ., Kalamazoo). Phys. Rev. Lett.; 28: No. 14, 923-5(3 Apr 1972).

Proton spin-flip in $^{12}C(p,p_1)^{12}C(2^+, 4.44\ MeV)$ was measured in the region of the narrow $^3/_2^-$ resonance near 8.18 MeV proton energy. Large interference is observed between the resonant and background spin-flip. The configuration of the resonant state in terms of a proton coupled to the 2^+ level of ^{12}C was obtained from a model-independent analysis. The data are sufficient to allow a self-consistent test of the theoretical formulation. (auth)

26886 MEASUREMENT OF THE SPIN-DEPENDENT PART OF THE SCATTERING AMPLITUDE OF SLOW NEUTRONS ON ^{19}F USING A POLARIZED BEAM AND A POLARIZED TARGET. Abragam, A.; Bacchella, G. L.; Long, C.; (and others) (CEN de Saclay, Gif-sur-Yvette, France). Phys. Rev. Lett.; 28: No. 13, 805-7(27 Mar 1972).

The spin-dependent part of the scattering amplitude of slow neutrons on ^{19}F was measured by using a polarized target of CaF_2. A value $\beta = a_+ - a_- = -0.135 \pm 0.002$ F was found, 10 times smaller than a recent theoretical estimate. A control experiment measuring $\beta = a_+ - a_-$ for the proton by Bragg scattering on a single crystal of LiH yielded the correct value within experimental error. (auth)

26887 ISOSPIN MIXING OF THE FIRST T = $^3/_2$ STATES IN ^9Be AND ^9B. Lin, W. K. (CRN, Strasbourg). Phys. Lett.; 37B: No. 5, 480-2(27 Dec 1971).

The contribution of the Coulomb interaction to the isospin mixing in $J^\pi = ^3/_2^-$ states of ^9Be and ^9B was calculated. It was found that this contribution only could not account for the measured widths for the first T = $^3/_2$ analog states. The importance of a charge-dependent nuclear force is investigated. (auth)

26888 CHARGED PARTICLES PRODUCED AS A RESULT OF NEGATIVE PION CAPTURE BY NUCLEI. Budyashov, Yu. G.; Zinov, V. G.; Konin, A. D.; Rabin, N. V.; Chatrchyan, A. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 62: No. 1, 21-30(Jan 1972). (In Russian).

Charged particles emitted as a result of absorption of stopped negative pions by Be, C, Al, S, Ca, Cu, Cd and Pb nuclei in samples of natural isotopic composition are identified in accordance with their masses. The energy spectra and relative probabilities for proton, deuteron and triton emission are measured at energies higher than 15, 18, and 24 MeV respectively. The probabilities for simultaneous emission of two charged particles are estimated. (auth)

26889 ONE-STEP PROCESSES IN THE INELASTIC EXCITATION OF UNNATURAL PARITY STATES BY ALPHA-PARTICLES. Love, W. G.; Owen, L. W. (Univ. of Georgia, Athens). Phys. Lett.; 37B: No. 5, 463-6(27 Dec 1971).

An estimate is made of the importance of one-step processes in the excitation of unnatural-parity states by the inelastic scattering of alpha particles. The contributions from both one-particle exchange effects and a realistic alpha–nucleon spin–orbit interaction are found to be small. Other velocity-dependent forces may be important. (auth)

26890 MOLECULAR SCATTERING STATES OF THE NEUTRON IN THE ELASTIC SCATTERING OF ^{12}C ON ^{13}C. Bohlen, H. G.; Von Oertzen, W. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett.; 37B: No. 5, 451-4(27 Dec 1971).

The angular distributions from elastic scattering of ^{12}C by ^{13}C at 15 MeV and 19 MeV (lab) were remeasured in the full angular range by means of a magnetic spectrometer. The analysis of the data based on the method of molecular wave functions is discussed using the two-center shell model (TCSM) and linear combination of nuclear orbitals (LCNO) approaches for the scattering states of the neutron. (auth)

26891 FRAGMENTATION OF ^{14}N NUCLEI AT 29 GeV: INCLUSIVE ISOTOPE SPECTRA AT 0°. Heckman, H. H.; Greiner, D. E.; Lindstrom, P. J.; Bieser, F. S. (Univ. of California, Berkeley). Phys. Rev. Lett.; 28: No. 14, 926-9(3 Apr 1972).

The first results of a Bevatron heavy-ion experiment on the inclusive spectra of isotopically identified nuclei, $3 \le Z \le 7$, produced by the fragmentation of 29-GeV ^{14}N ions in carbon and hydrogen are reported. The preliminary values of the partial differential cross sections at 0° give evidence that the modes of fragmentation of ^{14}N projectiles are independent of the target nucleus. (auth)

26892 STUDY OF ^6Li NUCLEUS DECAY FROM EXCITED STATES. Artemov, K. P.; Gol'dberg, V. Z.; Petrov, I. P.; Rudakov, V. P.; Serikov, I. N. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 14: No. 6, 1105-12(Dec 1971). (In Russian).

The decay of the ^6Li states populated in the reactions $^7Li(^3He,\alpha)^6Li$ and $^9Be(p,\alpha)^6Li$ was studied. A search for decay α particles from the 3.56-MeV (0^+) level, forbidden by spin and parity conservation in ^6Li, was made by the coincidence method. The upper estimate for the α width of this state is found to be $\Gamma_{\alpha+d} < 0.2$ eV. This estimate corresponds to the amplitude of admixture due to the presence of parity nonconserving forces $F < 4(10)^{-4}$. Investigation of the decay of the 5.35-MeV level in ^6Li allows one to assign the quantum numbers T = 1, $J^\pi = 2^+$ to this state. The estimate of the 5.35-MeV level width relative to the decay per α particle and deuteron is found to be $(\Gamma_{\alpha+d}/\Gamma)_{5.35} \le 0.12$. The estimate obtained of the admixture of the component with T = 0 is found to be $\alpha^2(T') \lesssim 0.05$. (4 figures) (auth)

26893 COMPARISON OF FESHBACH AND R-MATRIX REACTION THEORIES FOR $^{12}C(n,n)^{12}C$. I. SHELL MODEL. Robson, B. A.; Van Megan, W. J. (Australian National Univ., Canberra). Nucl. Phys.; A184: No. 1, 50-66(1972).

The Feshbach and R-matrix approaches to nuclear structure calculations in the continuum were applied to the elastic scattering of neutrons from ^{12}C below the inelastic threshold. A simple shell model was used for the positive-parity states of ^{13}C; in contrast to the work of Lovas [Nucl. Phys., 81: 353(1966)], the predictions of this model disagree significantly with experiments for both theories. The results for the two reaction theories are compared. (5 figures, 34 references) (auth)

26894 $^9Be(p,d_0)^8Be$ REACTION AND THE BHMM THEORY OF STRIPPING REACTIONS. Hudson, G. M.; Crinean, G. B.; Kelly, D. T.; Spicer, B. M. (Univ. of Melbourne). Nucl. Phys.; A184: No. 1, 175-92(1972).

Differential cross sections for the $^9Be(p,d_0)^8Be$ reaction were measured in detailed angular distributions for proton energies of 5 to 11 MeV in 1 MeV steps. Both BHMM and DWBA stripping theories are used to fit the data and obtain spectroscopic factors. It is shown that the data obtained over the range of energies can be used to select a parameter set for BHMM which yields spectroscopic factors very close to those given by the shell model, and which are nearly energy independent. Also, an effect probably due to a compound-nucleus resonance is observed near 8 MeV, this effect being noted with the application of both stripping theories. (auth)

26895 REACTION $^{14}C(^3He,p)^{16}N$ AND STRUCTURE OF ^{16}N. Freiesleben, H.; Weibezahn, R. (Univ., Marburg, Ger.). Nucl. Phys.; A184: No. 1, 273-84(1972).

The nucleus ^{16}N was studied in the reaction $^{14}C(^3He,p)^{16}N$. Angular distributions were measured between $\theta_{lab} = 5°$ and 60° at 15 MeV incident energy. The data were analyzed using DWBA and shell-model wave functions of Zuker, Buck, and McGrory. On the basis of the present results and previous $^{14}N(t,p)^{16}N$ data some new spins and parities are suggested. Transitions to the first negative-parity states and the 2p–2h structure of positive-parity states up to $E_x = 5.724$ MeV are discussed. (auth)

26896 MECHANISM OF $(\alpha,2\alpha)$ REACTIONS ON ^{12}C AND ^{16}O AT INTERMEDIATE ENERGIES. Mithra, B.; Laverriere, R. (Univ., Lyon). Nucl. Phys.; A184: No. 1, 330-6(1972).

From physical considerations, in the scheme of the dispersion approach to nuclear reactions with Feynman graphs, a triangular graph is chosen to study $(\alpha,2\alpha)$ reactions with ^{12}C and ^{16}O. The dependance of the α-particle angular distribution upon the quasi-free $\alpha-\alpha$ scattering at various energies is discussed; those cases in which it is justified to keep the $\alpha-\alpha$ cross section constant are determined. (7 figures) (auth)

26897 SPIN OF 4.8-MeV LEVEL OF ^8Be. Saxena, M. K. (Univ. of Lucknow, India). Indian J. Phys.; 44: No. 8, 466-8 (Aug 1970).

An ordinary lithium target was bombarded with 500-keV deuterons from the Cockroft–Walton high-voltage machine at the Tata Institute of Fundamental Research, Bombay. The outgoing neutrons were collected on 400-μ Ilford G5 nuclear research emulsion plates at seven angles, viz. 0°, 45°, 60°, 90°, 120°, 135°, and 150°. The neutron yield at the seven angles corresponding to the 4.8-MeV level of ^8Be was experimentally found. This value was compared with the predicted neutron yield from the theory of Butler. Of the various curves drawn for the yield at the different values of the proton angular momentum transfer the curve for $l_p = 1$ showed the closest fit to the observed data. The analysis yields that the spin of the 4.8-MeV level of ^8Be is 0 or 2 and of even parity. (1 figure) (auth)

26898 SEARCH FOR TRENDS IN TOTAL NEUTRON CROSS SECTIONS. Angeli, I. (Kossuth Univ., Debrecen, Hungary); Csikai, J.; Nagy, J. L.; (and others). Acta Phys. Acad. Sci. Hung.; 30: No. 2, 115-23(1971).

A survey of total neutron cross sections at 14 MeV suggests the existence of different trends in the data. In order to determine the reliability of data given by different authors, a statistical evaluation was carried out. It was found that the deviation in the data, measured in different laboratories for the same nuclei, is about one percent higher than the given limits of error. A simple empirical expression is given to describe the smooth oscillating de-

viations of measured values from the "black-nucleus" formula as a function of mass number. Experiments were performed under the same circumstances to search for the possible fine trends or systematic behavior in the cross sections, e.g. N – Z dependence, odd–even effect, correlation between nuclear radii and binding energies. The experiments were carried out in the "good geometry" arrangement at 14.7 MeV neutron energy. Total neutron cross sections were determined for N, O, Ar, Ca, Co, Ni, Cu, Zn, Ga, Ge, I, Cs, Ce, Pb, and Bi. (1 figure, 3 tables) (auth)

26899 STUDY OF THE ANGULAR DISTRIBUTION OF ^{9}Be + D NEUTRONS. Srivastava, M. L.; Sah, J. P. (Lucknow Univ., India). Curr. Sci. (India); 41: No. 4, 136-7(20 Feb 1972).

The ^{9}Be(d,n) reaction was studied at 650-keV deuteron energy. Neutron spectra were measured at 0 to 150° using nuclear emulsion plates. Angular distributions of neutron groups leading to the ground, 0.72-, and 1.75-MeV states in ^{10}B were obtained from the particle track densities. The data were analyzed on the basis of a stripping mechanism. Implications regarding angular momentum assignments are discussed. (J.W.R.)

26900 COMPARISON OF FESHBACH AND R-MATRIX REACTION THEORIES FOR ^{12}C(n,n)^{12}C. II. PARTICLE–ROTATOR MODEL. Robson, B. A.; Van Megen, W. J. (Australian National Univ., Canberra). Nucl. Phys.; A184: No. 1, 67-80(1972).

The Feshbach and R-matrix theories were applied to the reaction ^{12}C(n,n)^{12}C for incident energies below the inelastic threshold by using a particle–rotator model with a quadrupole residual interaction to describe the positive-parity states of ^{13}C. The results for the two reaction theories are compared. (7 figures) (auth)

26901 BACKWARD SCATTERING OF 14.1 MeV NEUTRONS FROM ^{12}C. Bonazzola, G. C.; Bressani, T.; Chiavassa, E.; Naldi, L.; Venturello, G. (Univ., Turin. Istituto Nazionale di Fisica Nucleare, Turin). Lett. Nuovo Cim.; 3: No. 3, 99-104(15 Jan 1972).

An experimental geometry which permits neutron angular distribution measurements to be extended to 178° is described. Neutron time-of-flight spectra for the elastic and inelastic scattering of 14.1-MeV neutrons from ^{12}C were measured at 152 to 178°. The elastic angular distributions were analyzed with an optical potential. (J.W.R.)

26902 APPLICATION OF THE SUDDEN APPROXIMATION TO THE ^{12}C(d,p$_0$)^{13}C REACTION. Goldfarb, L. J. B.; Hefter, E. F. (Univ. of Manchester, Eng.). Phys. Lett.; 38B: No. 6, 379-82(20 Mar 1972).

Calculations of the differential cross section and the proton polarization associated with the ^{12}C(d,p$_0$)^{13}C reaction and 51 MeV deuterons show that the sudden-approximation method of Butler et al. presents at least as good a description of the experimental data as is provided by the conventional DWBA. This feature supports the notion that the sudden approximation may have some validity at high energies. (auth)

26903 ^{14}C(p,γ_0)^{15}N CROSS SECTION FROM E$_p$ = 3.2 TO 7.7 MeV. Weller, H. R. (Univ. of Florida, Gainesville); Blue, R. A.; Bernstein, E. M.; Ramirez, J. J. Nucl. Phys.; A185: No. 1, 284-8(1972).

The 60° yield from the ^{14}C(p,γ_0)^{15}N reaction has been measured for proton bombarding energies between 3.2 and 7.7 MeV corresponding to ^{15}N excitation energies between 13.2 and 17.4 MeV. A broad structure is observed at about 15 MeV which corresponds to the so-called pygmy resonance previously observed in the ^{15}N(γ,p)^{14}C reaction. In the present work it is seen that this structure exhibits two peaks. Angular distributions measured in the vicinity of these peaks are isotropic. This structure is in the region of the giant dipole resonance. Assuming that the decay is pure E1 implies that these states have J$^{\pi}$ values of $\frac{1}{2}^{+}$. A T = $\frac{1}{2}$ assignment is suggested by the fact that a similar structure (previously assigned J$^{\pi}$ = ($\frac{1}{2}^{+}$, $\frac{3}{2}^{+}$)) is observed in the ^{14}N(p,γ_0)^{15}O reaction. These results are not accounted for by a recent shell-model calculation of the dipole states of the mass-15 nuclei. (auth)

26904 DETERMINATION OF THE MASS OF ^{15}O. Nero, A. V. (California Inst. of Tech., Pasadena). Nucl. Phys.; A185: No. 1, 213-16(1972).

A study of the ^{14}N(p,γ)^{15}O reaction shows that the 1.06-MeV resonance occurs at E$_p$(lab) = 1058.0 ± 0.5 keV and that the excitation energy of the corresponding ^{15}O state is 8284.1 ± 0.8 keV. These results yield an ^{15}O mass excess of 2855.9 ± 1.0 keV. (auth)

26905 THRESHOLD ENERGY FOR THE REACTION ^{15}N(p,n)^{15}O AND THE MASS OF ^{15}O. Jensen, H. B.; Mak, H. B.; Barnes, C. A. (California Inst. of Tech., Pasadena). Nucl. Phys.; A185: No. 1, 209-12(1972).

The threshold energy for the reaction ^{15}N(p,n)^{15}O has been remeasured and found to be 3772.7 ± 1.1 keV which is 8.1 keV lower than the currently accepted value. The ^{15}O mass excess inferred from this value is 2854.2 ± 1.1 keV. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 26850, 26881, 26888, 26971, 26972, and 26996.

26906 (JINR–P7-6262) SOME EXPERIMENTS ON STUDYING THE INTERACTION OF ACCELERATED Xe IONS WITH NUCLEI. Flerov, G. N.; Karamian, S. A.; Penionshkevich, Yu. E.; Tretiakova, S. P.; Shelaev, I. A. (Joint Inst. for Nuclear Research Dubna (USSR). Lab. of Nuclear Reactions). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

Cross sections of some interaction reactions of accelerated Xe ions with nuclei were measured. Cross sections of the exchange reactions were noticed to be growing in transitions from light bombarding particles (^{22}Ne, ^{40}Ar) to ^{136}Xe ions. The products of the compound nucleus reactions were identified in bombarding the targets of Mg and Zn; the cross sections of the reactions were determined to be: ^{24}Mg(^{136}Xe, 5n)^{155}Dy – 340 mb; ^{70}Zn(^{136}Xe, 4,5n) ^{202,201}Po – 31 and 52 mb, respectively. A search was performed for the spontaneously fissioning emitters in the interaction products of U and Xe nuclei. The boundary of $\sigma \leq 10^{-31}$ cm^2 was obtained for the production cross section of long-lived spontaneously fissioning emitters with the half-life of about 100 days. (auth)

26907 (ORNL-TM-3737) ^{23}Na(n,xγ) REACTION FOR 4.85 ≤ E$_n$ ≤ to 7.5 MeV. Dickens, J. K. (Oak Ridge National Lab., Tenn.). 3 Mar 1972. 29p. Dep. NTIS.

Interactions of neutrons with sodium have been studied by measuring gamma-ray-production cross sections. Spectra were obtained for incident mean neutron energies E$_n$ = 4.85, 5.4, 5.9, 6.45, 7.0 and 7.5 MeV. Data were obtained at angles of 125° and 55° using Ge(Li) detectors. Time-of-flight was used to discriminate against pulses due to neutrons and background radiation. Absolute cross sections for production of gamma rays were obtained for the incident neutron energies quoted above. The data have been compared with previous inelastic neutron scattering results and with evaluated cross sections with good agreement. The spectra were studied for gamma rays which could be associated with deexcitation of nuclear levels having unknown decay modes. Gamma rays were found having energies appropriate for decay of levels at excitation energies E$_x$ = 5762, 5934, 5967, 6115, 6576 and 6866 keV. (auth)

26908 BEHAVIOR OF THE EXCITATION FUNCTION OF (p,γ) REACTIONS IN THE VICINITY OF ISOBAR-ANALOG RESONANCES. Kopanets, E. G.; Migalenya, V. Ya.; L'vov, A. N.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1682-3(Aug 1971). (In Russian).

It is suggested that the simplicity of configuration of isobaric analog state influences the behavior of the excitation function in the neighborhood of isobaric analog resonances. An analysis of the excitation function was conducted on the reactions: ^{26}Mg(p,γ) ^{27}Al, ^{34}S(p,γ)^{35}Cl, and ^{40}Ar(p,γ)^{41}K, all leading to the formation of a nucleus with odd A. Histograms of the density of levels of the compound nucleus were prepared from a determination of the number of resonances found at 100 keV intervals of the incident protons. (K.S.W.)

26909 RADIATIVE PROTON CAPTURE AND ISOBAR-ANALOG STATES IN THE NUCLEI ^{27}Al, ^{35}Cl, AND ^{41}K. Kopanets, E. G.; L'vov, A. N.; Migalenya, V. Ya.; (and others) (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1676-81(Aug 1971). (In Russian).

At low energies of excitation the radiative proton capture method provides information on analog conditions. In a study of (p,γ) reactions, measurements were made in 200 to 300 eV steps in order to examine the fine structure of isobaric analog resonances. Targets were prepared by imbedding ions of ^{26}Mg, ^{34}S, or ^{40}Ar in a Ta support. The apparatus for studying the radiative capture of protons is schematically shown. Decay schemes for the isobaric analog states for ^{27}Al, ^{35}Cl, and ^{41}K are presented. (K.S.W.)

26910 DETERMINATION OF THE RADIATION WIDTH OF THE 6^{+}-STATE 8.79 MeV IN ^{20}Ne. Diamond, V. T.; Alexander, T. K.; Haeusser, O. (Chalk River Nuclear Lab., Ont.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1582-5(Aug 1971). (In Russian).

The γ ray spectrum was determined for the reaction ^{4}He (^{16}O,γ)^{20}Ne. Thin targets were filled with ^{4}He to a pressure of 2 torr. The yield of 4.54 MeV γ rays from the 6^{+} → 4^{+} transition was studied, with the conclusion that the target was sufficiently thick for resonance conditions. (K.S.W.)

26911 PROTON SCATTERING BY ^{26}Mg AND THE QUANTUM CHARACTERISTICS OF THE HIGHLY EXCITED STATES OF ^{27}Al. Vasil'ev, S. S.; Dem'yanova, A. S.; Mikhaleva, T. N.; Chuprunov, D. L. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1712-17(Aug 1971). (In Russian).

An analysis of the angular distributions and excitation functions was made for 6.18 to 6.73 MeV proton scattering by ^{26}Mg nuclei. (tr-auth)

26912 ENERGY DEPENDENCE OF PROTON POLARIZATION FOR ELASTIC SCATTERING BY ^{24}Mg. Bengali, N.; Galakhmatova, B. S.; Gulamov, I. R.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1695-6(Aug 1971). (In Russian).

The energy dependence of proton polarization during their elastic scattering by the ^{24}Mg nucleus was determined in the energy range 5.9 to 6.5 MeV for two scattering angles: 60 and 120°. Polarization was estimated by a double scattering method. (tr-auth)

26913 (d,p) AND (d,α) REACTIONS ON ^{34}S WITH 6.6 MeV DEUTERONS. Kolalis, R. P.; Nemilov, Yu. A.; Romanov, V. S.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1684-8(Aug 1971). (In Russian).

A sample of GeS with a 98% enrichment in ^{34}S was exposed to a beam of 6.6 MeV deuterons, and the angular distributions from the (d,p) and (d,α) reactions were determined. Experimental and theoretical cross sections for ^{32}P level formation were compared. Further discussion is centered around the following levels: 1.995, 2.722, and 3.422 MeV. (K.S.W.)

26914 INVESTIGATION OF THE REACTIONS ^{32}S(p,p)^{32}S, ^{26}Mg(p,p)^{26}Mg, AND ^{24}Mg(p,p')^{24}Mg WITH POLARIZED PROTONS. Lopatko, I. D.; Borovlev, V. I.; Andreev, G. B.; Slabospitskii, R. P. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1666-9(Aug 1971). (In Russian).

The excited states ^{33}Cl, ^{27}Al, and ^{25}Al were investigated by means of the elastic scattering of polarized protons by the nuclei ^{32}S and ^{26}Mg, and by inelastic scattering by ^{24}Mg. (tr-auth)

26915 LIFETIMES OF THE FIRST SIX EXCITED STATES OF ^{35}Cl. Van Reenen, R. J.; Naude, W. J.; Mouton, W. L. (Univ. of Stellenbosch, S. Afr.). Nucl. Phys.; A183: No. 3, 651-6(1972).

The mean lives of the six lowest levels of ^{35}Cl were determined by measuring the Doppler-shift attenuation of γ-rays observed in coincidence with inelastically scattered protons from the ^{35}Cl(p,p'γ)^{35}Cl reaction. The effect of experimental yield curve profiles throughout the finite target thickness was included in the stopping power calculations. From these measurements, mean lives of 215 ± 75, 205 ± 75, 185 ± 50, 65 ± 20, 18^{+26}_{-18} and >17,000 fs were obtained for the 1.22, 1.76, 2.65, 2.69, 3.00 and 3.16 MeV levels of ^{35}Cl, respectively. (auth)

26916 APPLICATION OF COLLECTIVE MODELS TO THE ^{28}Si NUCLEUS. Zarubin, P. P.; Kabakova, N. E.; Korb'etskii, E. V.; (and others) (Kiev State Univ. Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1730-5(Aug 1971). (In Russian).

An analysis was made of the literature values for elastic and inelastic scattering cross sections for protons and deuterons by ^{28}Si nuclei. It was concluded that the application of collective (sequential) models to the ^{28}Si nucleus must be limited to elastic and inelastic scattering of the first excitation state only (2^+_1). None of the three models examined satisfactorily describes higher excitation states. (K.S.W.)

26917 HYPERFINE STRUCTURE OF EXCITED STATES AND QUADRUPOLE MOMENT OF ^{21}Ne USING LASER-INDUCED LINE-NARROWING TECHNIQUES. Ducas, T. W.; Feld, M. S.; Ryan, L. W. Jr.; Skribanowitz, N.; Javan, A. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., A; 5: No. 3, 1036-43(Mar 1972).

Optical hyperfine structure in ^{21}Ne has been observed using laser-induced line-narrowing techniques. The output from a long stabilized single-mode 1.15-μ He–Ne laser is focused into an external sample cell containing ^{21}Ne. The laser field resonates with the ^{21}Ne 1.15-μ transition causing changes in the level populations over a narrow velocity range. Viewed along the laser axis, these population changes appear as narrow "change signals" superposed on the Doppler background of the spontaneous emission of the coupled 6096-Å transition. Analysis of the spectrum of these change signals, emitted parallel and antiparallel to the laser-field propagation direction, gives values for the hyperfine A constants for the three levels involved. These constants are analyzed by means of theoretical expressions wherein $\langle 1/r^3 \rangle$ of the 2p hole is the single important parameter. Combining the resulting value of $\langle 1/r^3 \rangle_{2p\ hole}$ for $1s_4$ level with a previous measurement of B($1s_5$) gives a value of Q(1s) = (0.093 ± 0.002) b, in agreement with an earlier less-accurate value. In addition, the ^{20,21,22}Ne isotope shifts are measured at 1.15 μ and 6096 Å. (auth)

26918 INFLUENCE OF PAIRING ON THE ROTATIONAL STATES IN sd SHELL NUCLEI. Goeke, K. (Univ., Muenster, Ger.); Faessler, Amand; Wolter, H. H. Nucl. Phys.; A183: No. 2, 352-70(1972).

For the description of rotational properties of nuclei the angular momentum projection after a Hartree-Bogoliubov variation procedure is explored. Calculations including T = 1 and T = 0 pairing are performed with the Yale force for the ground states of ^{22}Ne, ^{24}Ne, ^{24}Mg, ^{32}S, ^{30}Si and ^{36}Ar and the excited states of ^{28}Si, ^{30}Si and ^{32}S. The results are compared with angular momentum projected Hartree-Fock results and with available experimental data. The influence of pairing on energies, rms radii, quadrupole moments and B(E2) values is discussed. (auth)

26919 FORM FACTORS OF THE MONOPOLE TRANSITIONS IN ^{20}Ne BY INELASTIC ELECTRON SCATTERING. Mitsunobu, S.; Torizuka, Y. (Tohoku Univ., Tomizawa, Japan). Phys. Rev. Lett.; 28: No. 14, 920-2(3 Apr 1972).

The inelastic-electron-scattering form factors in ^{20}Ne for the E0 transitions from the 0^+ ground to the 6.72- (0^+) and 7.20-MeV (0^+) states are presented. The monopole matrix elements and transition charge radii are extracted from the form factors. (auth)

26920 ELASTIC AND INELASTIC SCATTERING AND SPIN-FLIP PROBABILITY FOR 7.5-MeV NEUTRONS SCATTERED BY A SILICON TARGET. McDonald, Malcolm Wheeler Jr. Athens, Ga.; Univ. of Georgia (1971). 107p. University Microfilms Order No. 72-11,007.

Thesis.

Using a pulsed deuteron beam derived from the University of Georgia 5.5-MV Van de Graaff accelerator neutrons of energy 7.5 MeV were produced by the D(d,n)^{3}He nuclear reaction. Measurements were made of the differential scattering cross sections for elastically (from the $J^\pi = 0^+$ ground state) and inelastically scattered (from the $J^\pi = 2^+$ first excited state) neutrons by a natural silicon target. The spin-flip probability of the inelastically scattered neutrons was measured by means of a technique involving the correlation of the de-excitation gamma rays ($2^+ \rightarrow 0^+$) with the inelastically scattered neutrons. The measurements were performed between the laboratory scattering angles of thirty degrees and one-hundred fifty degrees in ten-degree increments. Theoretical descriptions of the data were attempted using an antisymmetrized distorted wave approximation wherein the nuclear states are described by a microscopic model in terms of shell model single particle levels. A fair fit to the inelastic scattering cross section data was obtained. The predictions of the spin-flip probability by the formalism represented poor theoretical fits. (Diss. Abstr. Int., B)

26921 EXPERIMENTAL DETERMINATION OF DEFORMATION IN NUCLEI BY PHASE SHIFT MEASUREMENT. Gonchar, V. Yu.; Yushkov, A. V. (Inst. of Nuclear Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 830-5(Apr 1971). (In Russian).

Deformation of the nucleus may result in an ellipsoid of revolution, evidenced by a large quadrupole moment and lack of spherical symmetry. The degree of symmetry is reflected in the deviation of the nucleus from J. S. Blair's "phase rule". Experiments were conducted on ^{54}Cr and ^{68}Zn nuclei using a graphical method to determine phase shifts of oscillations of the inelastic scattering cross sections in relation to the elastic scattering of 38 MeV α-particles. The form of the nuclear surface is a function of both the magnitude and the sign (+ or –) of β, the quadrupole deformation. In addition, various isotopes of Mg, Si, Fe, Ni, and Mo were similarly studied. (K.S.W.)

26922 GAMMA RADIATION OF ^{29}Al, ^{34*}Cl, AND ^{51}Ti. Avchukhov, V. D.; Vasil'ev, S. S.; Dneprovskii, I. S.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 838-40(Apr 1971). (In Russian).

The γ spectra of nuclei with populated 1d- and 1f-shells: ^{29}Al, ^{34m}Cl, and ^{51}Ti were studied using a Ge(Li)-spectrometer. A proposed decay scheme for ^{29}Al is shown. (K.S.W.)

26923 SEARCH FOR γ EMISSIONS FROM β DISINTEGRATING ^{32}Si. Forberg, S. (Royal Inst. of Tech., Stockholm). Radiochem. Lett.; 9: No. 3, 147-53(22 Feb 1972).

A 0.1 μCi source of the rare nuclide ^{32}Si was produced and used in a search for γ-emission between 20 and 200 keV, by means of a coaxial Ge(Li) detector and a 400-channel analyzer. The one-week spectrum was smoothed by computer. If any γ quanta are emitted, their intensities per 10^6 disintegration are: <200 emissions above 20 keV; <20 above 30 keV; <10 above 50 keV; and <10 at 77 keV, the only known energy level of ^{32}P that might yield γ-emissions. (auth)

26924 POSSIBLE SOLUTION TO THE ^{27}Al PUZZLE. Dehnhard, D. (Univ. of Minnesota, Minneapolis). Phys. Lett.; 38B: No. 6, 389-92(20 Mar 1972).

B(E2) transition rates between ^{27}Al states and spectroscopic factors for nucleon pickup from ^{28}Si calculated in the Coriolis bandmixing model are found in good agreement with experiment if an oblate shape is assumed for ^{27}Al. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 26847, 26850, 26873, 26877, 26898, 26908, 26909, 26921, 26946, 26954, 26959, 26972, 26994, 27039, and 27102.

26925 COMPARISON OF NUCLEAR CHARACTERISTICS OBTAINED FROM THE INELASTIC SCATTERING OF NEUTRONS, PROTONS, AND DEUTERONS BY ^{46,48}Ti, ^{56}Fe, AND ^{60,64}Ni. Gofman, Yu. V.; Gurtovoi, M. E.; Kabakova, N. E.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1700-6(Aug 1971). (In Russian).

The differential cross sections of elastic and inelastic proton scattering (13 and 14.4 MeV) by ^{48}Ti and ^{60}Ni were analyzed in an attempt to establish which of five low states for each nucleus may be attributed to a collective excitation. In addition, the elastic and inelastic scattering of 13.6 MeV deuterons with excitation of the first state (2^+) by the nuclei ^{46}Ti, ^{48}Ti, ^{56}Fe, ^{64}Ni, and of 14 MeV neutrons by the nuclei ^{48}Ti and ^{56}Fe were investigated. The results were compared with those obtained from an analysis of the cross sections of inelastic scattering for different bombarding particles. (K.S.W.)

26926 STUDY OF THE ELECTROMAGNETIC TRANSITIONS IN THE ^{55}Co NUCLEUS. Shoup, R. (Florida State Univ., Tallahasse); Fox, J. D.; Brown, R. A.; Vourvopoulos, G.; Maripuu, S. Nucl. Phys.; A183: No. 1, 21-32(1972).

The γ-decay of the excited levels of ^{55}Co was studied via the ^{54}Fe(^{3}He, dγ)^{55}Co reaction. A γ-ray decay scheme and energy level diagram were constructed for levels in ^{55}Co up to 5.7 MeV excitation. Branching ratios were calculated and more conclusive spin assignments were made for most of these levels. The γ-ray branching of the $\frac{3}{2}^-$ $T_>$ state suggests that the excited levels in ^{55}Co are best described by mixed nuclear configurations. (auth)

26927 ELASTIC AND INELASTIC SCATTERING OF PROTONS BY ^{54}Fe NUCLEI. Antoropov, A. E.; Zarubin, P. P.; Ioannu, P. D.; Orlov, B. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1718-25(Aug 1971). (In Russian).

The elastic and inelastic scattering of 6 MeV protons by the isotope ^{54}Fe was studied. The available literature data on proton scattering by ^{54}Fe, ^{56}Fe, and ^{58}Fe was systematized. Peculiarities in the values for elastic and inelastic scattering were attributed to differences in the threshold of the (p,n) reactions for the subject nuclei. The deformation of the ^{58}Fe nucleus and the contributions of direct processes in inelastic proton scattering were determined at energies of 6 MeV for the nuclei ^{54}Fe and ^{56}Fe. (tr-auth)

26928 FINE STRUCTURE OF THE GIANT RESONANCE IN ^{58}Ni. Dubovoi, E. I.; Nadtochii, V. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1742-3(Aug 1971). (In Russian).

The resonance structure of the photoneutron cross section for the ^{58}Ni nucleus was analyzed by means of a triangular Feynman diagram, which describes the aggregate of the decay processes in the reaction ^{58}Ni → ^{57}Ni + n. The spectrum of extremums E_γ^{res} are tabulated as taken from the literature on known resonances of the photoneutron cross section for ^{58}Ni for purposes of discussion. (K.S.W.)

26929 LEVEL STRUCTURE OF ^{49}Ti. Ball, A. E. (Univ. of Bradford, Eng.); Brown, G.; Denning, A.; Glover, R. N. Nucl. Phys.; A183: No. 3, 472-96(1972).

The level structure of ^{49}Ti has been studied up to an excitation energy ≈6.3 MeV using the ^{47}Ti(t,p), ^{48}Ti(d,p) and ^{49}Ti(p,p′) reactions. Thirteen L = 0 transitions were observed in the ^{47}Ti(t,p) ^{49}Ti reaction, thus identifying thirteen $J = \frac{1}{2}^-$ states in ^{49}Ti. These observations show the occurrence of 2p-3h configurations at quite low excitation energies in ^{49}Ti. The difficulty in observing the full $f_{\frac{1}{2}}$ single-particle strength in the ^{48}Ti(d,p) reaction can be accounted for at least in part, by considerable fragmentation of the strength due to mixing with such $J = \frac{5}{2}$ configurations. The summed value of (2J + 1)S for $J = \frac{1}{2}^-$ states exceeds the theoretical limit and therefore, in agreement with the ^{47}Ti(t,p) data, also indicates the existence of 2p-3h configurations in the wave functions of levels of ^{49}Ti. The present level scheme accounts for most of the γ-rays reported from thermal neutron capture experiments. (auth)

26930 LEVEL INVESTIGATION BY MEANS OF THE (d,α) REACTION. II. ^{52}Mn AND ^{56}Mn. Kelleter, H.; Bachner, D.; Schmidt, B.; Seliger, W. (Univ., Bonn). Nucl. Phys.; A183: No. 3, 509-22(1972).

The reactions ^{54,58}Fe(d,α)^{52,56}Mn have been studied using 15 MeV deuterons, and angular distributions of outgoing α-particles have been measured up to an excitation energy of about 3 MeV and 1.3 MeV respectively. Some unexpected deviations from the direct reaction mechanism are shown for the ^{54}Fe(d,α)^{52}Mn reaction, which might possibly be due to special configurations in the $1f_{\frac{1}{2}}$ shell. Angular momenta as well as spectroscopic strengths have been determined by means of DWBA calculations. In particular an approximate relation was sought which would enable an interpretation of spectroscopic strengths even in the case of configuration mixing. The results provide spectroscopic information about the amount of seniority and configuration mixing in the level structure of the ^{52,56}Mn isotopes. (auth)

26931 STUDY OF THE REACTION ^{58}Ni(d,p)^{59}Ni FOR BOMBARDING PARTICLES WITH ENERGIES BELOW THE POTENTIAL BARRIER. Nemilov, Yu. A.; Litvin, V. F.; Zherebtsova, K. I.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1826-9(Aug 1971). (In Russian).

The excitation character of levels of the nucleus ^{59}Ni in the reaction ^{58}Ni(d,p)^{59}Ni with sub-barrier energy deuterons is elucidated. The proton spectrum for this reaction, E_d = 2.9 MeV, and $\theta = 90°$, is reproduced graphically. The method of distorted waves gives the correct quantitative interpretation of differential cross sections of excitation in (d,p) reactions of levels of the ^{59}Ni nucleus, bearing single-particle character, and at sub-barrier energies. The group of ^{59}Ni levels exhibit a sharply increased cross section of excitation in (d,p) reactions in comparison with that predicted by the distorted wave method. (K.S.W.)

26932 TOTAL ANGULAR MOMENTA OF THE 4.532 AND 4.639 MeV LEVELS OF ^{41}Sc. Soroka, V. I.; Stryuk, V. S.; Mal'ko, A. I. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 8, 1393-4(Aug 1971). (In Russian).

Polarization data were conveniently used to obtain the total angular momenta of the states of the compound nucleus formed by proton scattering by ^{40}Ca. A Ca foil of natural isotopic composition formed the first target, the second was He. Angular momenta were calculated from the investigated ^{41}Sc levels: 4,532 keV ($J^\pi = \frac{3}{2}^-$) and 4,639 keV ($J^\pi = \frac{1}{2}^-$) (K.S.W.)

26933 EFFECTIVE WAVE FUNCTION CALCULATION OF THE $J^\pi = 0^+$ STATES OF THE Ca-ISOTOPES THROUGH THE (t,p) AND (p,t) REACTIONS. Broglia, R. A. (Univ. of Copenhagen. State Univ. of New York, Stony Brook); Kolltveit, K.; Nilsson, B. Phys. Lett.; 37B: No. 5, 441-5(27 Dec 1971).

The amplitudes of the spherical and deformed components of the $J^\pi = 0^+$ states of the Ca isotopes connected by (t,p) and (p,t) reactions are considered as variational parameters and are determined by fitting the corresponding two-neutron-transfer-reaction cross sections. The influence of the deformed components in these reactions is assessed. By utilizing finite-range results and appropriate wave functions the absolute value of the cross sections is reproduced. (auth)

26934 INELASTIC ^{3}He SCATTERING OF $f_{\frac{1}{2}}$ SHELL NUCLEI AS A CONSISTENT TEST OF THE MICROSCOPIC APPROACH. Morsch, H. P.; Santo, R. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett.; 37B: No. 5, 491-3(27 Dec 1971).

Inelastic ^{3}He scattering to positive-parity states in ^{44}Ca, ^{46}Ti, ^{48}Ti, ^{50}Ti, ^{50}Cr, and ^{52}Cr was measured at 29 MeV and analyzed with the microscopic model. With theoretical $f_{\frac{1}{2}}$ wave functions and a Gaussian of 1.85 fm width for the effective interaction a constant value of about 50 MeV was obtained. (auth)

26935 SINGLE-NEUTRON HOLE STATES IN ^{39}Ar. Wiza, J. L. (St. Joseph's Coll., Philadelphia); Garrett, J. D.; Middleton, R. Nucl. Phys.; A183: No. 2, 439-48(1972).

The levels of ^{39}Ar below an excitation energy of 11.4 MeV have been investigated using the ^{40}Ar(^{3}He, α) reaction at a bombarding energy of 16.5 MeV. Fifty-nine previously unreported states of ^{39}Ar were observed. Angular distributions corresponding to strong transitions have been compared with distorted-wave Born-approximation calculations. The transitions to the levels at 9.075 and 9.463 MeV excitation are consistent with a previous suggestion that these levels are the $T = \frac{5}{2}$ isobaric analogs of the ground and first excited states of ^{39}Cl. The extracted spectroscopic factors are discussed in terms of the shell-model sum rule. New spin and parity assignments of $\frac{3}{2}^+(\frac{5}{2}^+)$, $\frac{1}{2}^+$ and $\frac{1}{2}^+$ are made for the levels at 9.075, 9.463 and 11.312 MeV, respectively. (auth)

26936 INVESTIGATION OF EXCITED STATES IN ^{41}K FROM THE ^{40}Ar(p,γ)^{41}K REACTION. Piiparinen, M. (Helsinki Univ.). Ann. Acad. Sci. Fenn., Ser. A VI; No. 371, 1-15(1971).

The level structure of ^{41}K has been studied using the ^{40}Ar(p,γ) ^{41}K reaction on an isotopically separated target of ^{40}Ar. The decay schemes for five resonances and energies, and branching ratios of 23 bound states have been obtained by means of a 38 cm^3 Ge(Li) detector. The Q-value was determined to be 7804.2 ± 1.8 keV. Two resonances (Ep = 1102 and 1605 keV) have been proposed as the isobaric analogue resonances for the second and third excited states of ^{41}Ar. Lifetimes or lifetime limits of 11 levels of ^{41}K were determined by the Doppler-shift attenuation method. (auth) (Finland)

26937 IZOBARNYE YADRA S MASSOVYM CHISLOM A = 147. (Isobaric Nuclei with Mass Number A = 147). Avotina, M. P.; Zolotavin, A. V. Svoistva Atomnykh Yader, Vypusk 11. (Properties of Atomic Nuclei, No. 11). Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1971). 152p.

The eight known isobaric isotopes with the same mass number, 147, comprise the consecutive rare earths Ce through Tb, and, collectively, they experience β^- decay, ec and β^+ decay, and α decay. These three types of transitions, the properties of the parent and daughter products, emission energies, and decay schemes are discussed in detail. Data relating to half-lives, quantum characteristics of excited levels, and decay probabilities are included. Extensive bibliography. (K.S.W.)

26938 γ-DECAY OF THE $p_{\frac{1}{2}}$ ANALOG STATE OF ^{43}Sc. Goode, K.; Kemp, K.; Naumov, Yu. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 687-97(Apr 1971). (In Russian).

The gamma decay of the 6142-keV ^{43}Sc analog state was studied by bombarding a ^{42}Ca target with 1424-keV protons in a van de Graaff accelerator. The decay scheme of the $p_{\frac{1}{2}}$ analog resonance was constructed. A spin-flip type of the γ-decay of an analog state is interpreted in the discussion. (K.S.W.)

26939 PAIR CONVERSION IN ^{42}Ca. Belyaev, B. N.; Vasilenko, S. S.; Kaminker, D. M. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 806-9(Apr 1971). (In Russian).

The positron spectrum for pair conversion was determined during the decay of ^{42}K. The multipolarities of the 1,930 keV and 2,420 keV transitions were determined which do not contradict the values of the spins 3,442 keV (3^-) and 2,422 keV (2^+) which had been established from (p,p') and (α,α') reactions. (tr-auth)

26940 REASONS FOR THE LOWERING OF THE LEVELS $s_{\frac{1}{2}}$ AND $d_{\frac{3}{2}}$, CAUSED BY HOLES IN POPULATED SHELLS. Peker, L. K.; Volmyanskii, E. I.; Voronkov, Yu. P.; Kazakov, A. L. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 856-7(Apr 1971). (In Russian).

Properties of low excited states of the $d_{\frac{3}{2}}$ type of nuclei with A = 40 to 50 are associated with hole formation in the populated shell Z, N = 20. Recently a similar low level $3s_{\frac{1}{2}}$ in the isotopes $^{201\text{to}207}$Bi was reported. It is suggested that an interaction occurs between holes and nucleons under certain conditions, and that in the isotopes ^{43,45,47}Ca, and ^{43,45,47}Sc, the number of nucleons interacting with holes at $d_{\frac{3}{2}}$ is greater than in the case of the isotopes ^{205,207}Bi (which also leads to particle-hole interaction). (K.S.W.)

26941 NUCLEAR SPECTROSCOPY OF ^{50}Cr. Raman, S. (Oak Ridge National Lab., Tenn.); Auble, R. L.; Milner, W. T.; (and others). Nucl. Phys.; A184: No. 1, 138-56(1972).

The nuclear excited states of ^{50}Cr were studied by means of the decay of 1.7-min ^{50}Mn, the ^{50}Cr(p,p'γ) and ^{52}Cr(p,t) reactions, and Coulomb excitation with ^{35}Cl ions. Gamma-ray branching ratios and precise level energies were obtained for 23 excited states in ^{50}Cr. The L values from the (p,t) reaction are employed to suggest or confirm the spin and parity assignments for eight excited states. The mean lifetime of the 783.3-keV 2^+ state was determined as 12.1 ± 1.2 ps from the measured B(E2) ↑ value and as 10 ± 2 ps from Doppler-shift measurements. The experimental level scheme for ^{50}Cr is compared with that for the cross-conjugate nucleus ^{46}Ti and with a calculated level scheme. (auth)

26942 GAMMA-RAY DECAY FROM THE ANALOGUE STATE OF THE ^{49}Ca g.s. Gaarde, C.; Kemp, K.; Petresch, C.; Folkmann, F. (Univ. of Copenhagen). Nucl. Phys.; A184: No. 1, 241-52 (1972).

The γ decay from three fine-structure components of the ^{49}Ca ground state analog was investigated. Angular distributions were measured for the decay from the strongest component. Absolute γ widths were found from the γ spectra; and the proton and neutron widths, from fits to the ^{48}Ca(p,p) and (p,n) excitation functions. A group of eight states with E_x around 7 MeV was found to carry a significant part of the M1 strength. A comparison with the β decay of ^{49}Ca was made. (auth)

26943 ELECTROMAGNETIC PROPERTIES OF ^{53}Cr. Carola, T. P. G.; Tamboer, J. G. (Univ., Utrecht). Nucl. Phys.; A185: No. 1, 81-93(1972).

Lifetimes, excitation energies, decay modes, and spins of ^{53}Cr levels with E_x < 3.3 MeV, have been determined in the ^{50}Ti(α,nγ) ^{53}Cr reaction. Previous tentative $J^\pi = \frac{7}{2}^-$ assignments to the 1.29 and 1.54 MeV levels have been confirmed. New spins and parity assignments are $J^\pi = \frac{5}{2}^-$ and $\frac{3}{2}^-$ for the 1.97 and 2.71 MeV respectively. Multipole mixing ratios are given for many of the observed transitions. The measured lifetimes of 12 levels are compared with recent shell-model and intermediate coupling model calculations. (auth)

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Refer also to abstracts 25661, 26850, 26898, 26906, 26921, 26925, 26931, 26960, 26971, 26972, 26988, 26994, 26996, 27020, 27061, and 27102.

26944 (AAEC/E-214) FISSION PRODUCT GROUP CROSS SECTION LIBRARY. Bertram, W. K.; Clayton, E.; Cook, J. L.; Ferguson, H. D.; Musgrove, A. R.; Rose, E. K. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1971. 200p. Dep. NTIS (U. S. Sales Only).

A compilation of calculated group cross sections for 184 fission product nuclei and 8 isomeric states is given. Radiative capture, elastic and inelastic scattering and total cross sections are given for neutron energies in 127 groups up to 15 MeV. (auth)

26945 (JINR-P6-6249) DECAY OF ^{83}Y(7.4 MIN) AND ^{83m}Y (2.6 MIN). Abdurazakov, A. A.; Balanda, A.; Kracik, B.; Toshev, M.; Chamraev, F.; Tran-Thanh-Minh (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). Feb. 1972. 16p. (In Russian). Dep. NTIS (U.S. Sales Only).

The spectra of ^{83}Y and ^{83m}Y gamma-rays were studied. The decay scheme of ^{83}Y and ^{83m}Y is suggested. (auth)

26946 (RLO-1388-160) NEUTRON-GAMMA COMPETITION FOLLOWING (d,d') REACTIONS. Ling, C.; Bodansky, D.; Calarco, J. R.; Cameron, J. M. (Washington Univ., Seattle. Dept. of Physics). [1971]. 61p. Dep. NTIS.

The (d,d'n) reaction was studied in ^{61}Ni and other targets using 19-MeV deuterons. Deuteron angular distributions and yields indicate that the (d,d') reaction is predominantly direct at forward angles, but probably has a large compound nuclear component at backward angles, and observed angular correlations for d'-n coincidences indicate that the neutrons are mainly products of evaporation from a ^{61}Ni compound nucleus. The fractional yield, $F_n = \Gamma_n/\Gamma$, for neutron emission is found to be substantially below unity for ^{61}Ni excitation energies E_i extending to several MeV above the neutron binding energy B_n(e.g., $F_n \simeq 0.75$ at $(E_i - B_n) \simeq$ 2 MeV), indicating the importance of competition from gamma ray emission. For $(E_i - B_n) < 3$ MeV, F_n is independent of deuteron angle and its magnitude can be accounted for in terms of the statistical model. Because the relative neutron and gamma ray emission widths are strongly dependent on the ^{61}Ni spin population, this lack of dependence of F_n on deuteron detection angle suggests that the ^{61}Ni spin population is similar for direct and compound nuclear (d,d') reactions. For $(E_i - B_n) > 3$ MeV, the value of F_n at forward deuteron angles is anomalously low. Results are also presented for the (d,d'n) reaction in ^{25}Mg, ^{57}Fe, ^{91}Zr, and ^{119}Sn. (auth)

26947 INVESTIGATION OF ISOBAR-ANALOG RESONANCES OF ^{63}Cu AND ^{67}Ga WITH A POLARIZED PROTON BEAM. Lopatko, I. D.; Borovlev, V. I.; Slabospitskii, R. P.; Lutsik, V. A.; Andreev, G. B. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1707-11(Aug 1971). (In Russian).

The polarization of protons elastically scattered by ^{62}Ni and ^{66}Zn was measured for the purpose of determining the total angular momenta of isobaric analog resonances in ^{63}Cu and ^{67}Ga. The ^{62}Ni measurements were performed with 2.40 to 2.75 MeV protons and at scattering angles 90 and 140°; the ^{66}Zn measurements were performed with 2.7 to 2.9 MeV protons at angles of 120 and 150°. The total angular momenta and parity of the excited analog states of ^{63}Cu at E_p = 2.49 and 2.66 MeV are equal to $\frac{1}{2}^-$ and $\frac{3}{2}^-$. For E_p = 2.760 and 2.850 MeV in ^{67}Ga the analog states of ^{67}Zn are formed with $I^\pi = \frac{5}{2}^-$ and $\frac{1}{2}^-$, respectively. (K.S.W.)

26948 LEVELS OF ^{70}Ga EXCITED IN THE REACTION ^{70}Zn(p,γ)^{70}Ga. Guzhovskii, B. Ya.; Abramovich, S. N.; Zvenigorodskii, A. G.; Trusillo, S. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1697-9(Aug 1971). (In Russian).

Gamma spectrum which resulted from the reaction ^{70}Zn(p,nγ) ^{70}Ga using protons in the energy range 2 to 4 MeV was determined with the aid of a Ge(Li) spectrometer. The energy of 26 direct γ-transitions was measured for ^{70}Ga ($E_\gamma \leq 2.4$ MeV), and also 14

cascade transitions were evaluated. The decay scheme and energy levels of ^{70}Ga were established. (tr-auth)

26949 GAMMA RADIATION OF ^{65}Ga. Dzhelepov, B. S.; Popova, T. I.; Prikhodtseva, V. P.; Tsaritsyna, L. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1575-81(Aug 1971). (In Russian).

The spectrum of the γ radiation of ^{65}Ga ($T_{\frac{1}{2}}$ = 15.2 min) was produced by the reaction ^{56}Fe(^{11}B,2n)^{65}Ga and studied with a Ge(Li) detector with a sensitive volume of about 33 cm^3. The energy and intensity of 24 lines were determined; of these 21 lines were undoubtedly connected with the decay of ^{65}Ga. The intensity of γ radiation was computed in percentage of the disintegrations and the log ft values were calculated for the β-transitions. (tr-auth)

26950 ANOMALIES IN THE COULOMB STRIPPING ^{64}Ni(d,p)^{65}Ni AT E_d = 2.9 MeV. Litvin, V. F.; Nemilov, Yu. A.; Krasnov, L. V.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1689-92(Aug 1971). (In Russian).

The energy spectrum and angular distribution of protons were determined for the reaction ^{64}Ni(d,p)^{65}Ni for E_d = 2.9 MeV for several levels of the residual nucleus. A spectroscopic factor was found which was essentially different from that found earlier for stripping exceeding the barrier energy. The possible cause of this anomaly is discussed. (tr-auth)

26951 ^{89}Y($\vec{d}$,n$_0$)^{90}Zr REACTION AND COULOMB EFFECTS IN STRIPPING REACTIONS. Quinn, P. A.; Davis, J. C.; Hilscher, D. (Univ. of Wisconsin, Madison). Nucl. Phys.; A183: No. 1, 173-6 (1972).

The vector analyzing power of the ^{89}Y($\vec{d}$,n$_0$)^{90}Zr reaction has been measured for lab angles between 2.5° and 45° at a deuteron energy of 11 MeV. The angular momentum and parity of the transferred proton are known to be $j_p^\pi = \frac{1}{2}^-$, but the angular dependence of the vector analyzing power is similar to that observed in ($\vec{d}$,p) transitions with $j_n^\pi = \frac{5}{2}^-$. The results of distorted-wave calculations are in qualitative agreement with the measured angular dependence of the ($\vec{d}$,n) vector analyzing power and predict a j-dependence for ($\vec{d}$,n) reactions similar to that observed in ($\vec{d}$,p) reactions. These calculations indicate that the observed difference in the vector analyzing power between ($\vec{d}$,n) and ($\vec{d}$,p) reactions arises primarily from Coulomb effects in the outgoing channel. (auth)

26952 LIFETIMES OF LEVELS IN ^{66}Zn. Youngblood, D. H.; Kozub, R. L.; Hill, J. C. (Texas A and M Univ., College Station). Nucl. Phys.; A183: No. 1, 197-202(1972).

The mean lifetimes of several levels excited by inelastic α-scattering on ^{66}Zn were measured using the attenuated Doppler-shift technique. The data were analyzed using the universal stopping cross sections of Lindhard, Scharff and Schiøtt. The excitation energies obtained and their lifetimes are: 1.040 MeV ($2.1^{+1.0}_{-0.7}$ ps), 1.874 MeV (<2 ps), 2.452 MeV (<1 ps), 2.828 MeV (0.26 ± 0.05 ps), 3.080 MeV ($0.19^{+0.09}_{-0.13}$ ps) and 4.395 MeV (98^{+60}_{-30} fs). (auth)

26953 LEVEL INVESTIGATION BY MEANS OF THE (d,α) REACTION. I. ^{62}Cu. Bachner, D.; Kelleter, H.; Schmidt, B.; Seliger, W. (Univ., Bonn). Nucl. Phys.; A183: No. 3, 497-508 (1972).

The reaction ^{64}Zn(d,α)^{62}Cu has been performed with 15 MeV deuteron energy. Angular distributions of the outgoing α-particles have been extracted up to an excitation energy of about 4 MeV and angular momenta have been determined by means of DWBA calculations. As this reaction is the first of a series of (d,α) reactions carried out on target nuclei in the fp shell, the DWBA formalism and some features of the analysis when applied to (d,α) reactions in the fp shell are discussed. Especially a spin-orbit effect, connected with the maximum coupling possibility of $(2p_{\frac{3}{2}}\ 1f_{\frac{7}{2}})^2$ shell model configurations in the reactions, is discussed. (auth)

26954 ELASTIC SCATTERING OF 33 MeV ^{3}He PARTICLES FROM ^{58,60,62,64}Ni, ^{63,65}Cu, AND ^{64,66,68}Zn. Cage, M. E.; Clough, D. L.; Cole, A. J.; (and others) (Univ. of Birmingham, Eng.). Nucl. Phys.; A183: No. 3, 449-71(1972).

Differential cross sections have been measured of the elastic scattering of 33 MeV ^{3}He particles from targets of ^{58,60,62,64}Ni, ^{63,65}Cu and ^{64,66,68}Zn over the angular range 5° to 175°. The data have been analyzed with the optical model, with particular emphasis on the investigation of the ambiguities in the real potential, the form of the imaginary potential and the use of a spin-orbit term. (auth)

26955 HANDBOOK OF NUCLEAR DATA FROM NEUTRON ACTIVATION ANALYSIS. Aliev, A. I.; Drynkin, V. I.; Leipunskaya, D. I.; Kasatkin, V. A. Jerusalem; Israel Program for Scientific Translations Ltd. (1970). 173p. (IPST-Cat.-2222). International Scholarly Book Services, Inc., Portland, Oreg.

Translation of Yadernofizicheskie Konstanty Dlya Neitronnogo Aktivatsionnogo Analiza. Spravochnik. Translated from Russian by Baruch Benny.

The most reliable and accurate data on neutron activation cross sections and the characteristics of the activation products have been compiled in handbook form. Chapters are included on thermal and fission neutron activation data, activation cross sections for neutrons with energies close to 14 MeV, decay products of radioactive isotopes formed by neutron activation, classification of radioactive isotopes according to half-lives and γ energies, perturbation effects of the neutron field in activation analysis, and excitation function diagrams of neutron threshold reactions. (J.W.R.)

26956 ANALYSING POWER AND SPIN DEPENDENCE IN INELASTIC SCATTERING OF PROTONS FROM ^{63}Cu AND ^{65}Cu. Dost, M.; Glashausser, C.; Haynes, C. F. (Rutgers-The State Univ., New Brunswick, N. J.). Nucl. Phys.; A183: No. 2, 285-8(1972).

Analyzing power measurements in the inelastic scattering of 15.7 MeV protons from ^{63}Cu and ^{65}Cu reveal only small differences between $\frac{1}{2}^-$, $\frac{5}{2}^-$ and $\frac{7}{2}^-$ angular distributions, in contrast to the corresponding differential cross-section measurements. (auth)

26957 COMPARISON WITH NUCLEAR EVAPORATION THEORY USING 3.5 GeV/c π^- MESONS. Fox, Jay A. (Univ. of South Carolina, Columbia). Particles Nucl.; 2: No. 5, 326-40(Nov 1971).

The predictions of nuclear evaporation theory are tested at high excitation energies by observing singly and doubly charged particles with kinetic energies less than 35 MeV emanating from Ag and Br nuclei which have interacted with 3.5 GeV/c π^- mesons. Measurements of energy spectra, angular distributions, the ratio of the number of doubly to singly charged evaporated particles, and excitation energy are made and generally agree with theoretical predictions. Phenomena not predicted by elementary evaporation theory are also described and include the presence of sub-barrier alphas, the asymmetrical angular distribution of tracks with ranges less than 20 microns in nuclear emulsion, and the fact that the emission of doubly charged particles becomes more favorable at higher excitation energies. (auth)

26958 PROPERTIES OF LOW EXCITED LEVELS OF ^{85}Sr AND ^{99}Tc. Voinova, N. A.; Egorov, A. I.; Kalinichev, Yu. V.; Sergeev, A. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 861-6 (Apr 1971). (In Russian).

The decay schemes of ^{99}Mo, ^{99m}Tc, and ^{85,85m}Sr were studied by measuring the internal conversion coefficients with a specially-calibrated spectrometer. The isotopes ^{85m}Sr and ^{99}Mo were produced by an (n,γ) reaction with 61% enriched ^{84}Sr and natural Mo, respectively. The conversion electron spectra are reproduced graphically for the isotopes ^{85}Sr, ^{99}Mo, and ^{99m}Tc. (K.S.W.)

26959 USE OF THE STATISTICAL MODEL FOR (n,n'γ) CROSS SECTIONS IN THE MASS RANGE A = 46 TO 88. Uhl, M. (Institut fuer Radiumforschung und Kernphysik, Vienna). Nucl. Phys.; A184: No. 1, 253-72(1972). (In German).

(n,n'γ) cross sections for 19 even isotopes of Ti, Cr, Fe, Ni, Zn, Ge, Se, and Sr were calculated by using an accurate version of the statistical model. The influence of the various parameters of the model is examined. The results are compared with experimental cross sections for 14-MeV neutrons; after applying a correction for direct-interaction contributions, the agreement is satisfactory. The connection between the systematic behavior of the (n,2n) cross sections and that of the (n,n'γ) cross sections is discussed. (auth)

26960 COULOMB STRIPPING IN $^{58\ 62\ 64}$Ni(d,p)$^{59\ 63\ 65}$Ni. Litvin, V. F.; Nemilov, Yu. A.; Krasnov, L. V.; (and others) (Inst. of Radium, Leningrad). Nucl. Phys.; A184: No. 1, 105-12(1972).

The ^{58,62,64}Ni(d,p) stripping reactions were studied up to a high excitation energy at an incident deuteron energy of E_d = 2.9 MeV. The spectroscopic factors (2J + 1)S for some excited states differ from those measured at an incident deuteron energy above the Coulomb barrier. For high excited states these anomalies can be explained by the wrong assignment of l_n in previous investigations. For low-lying levels of the residual nuclei, the proton energy exceeds the Coulomb barrier, and the anomalies observed are apparently due to multistep stripping. (auth)

26961 ANOMALIES IN THE ^{89}Y(α,n)^{92}Nb CROSS SECTION NEAR ISOBARIC ANALOG RESONANCES. Richter, A. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Grosse, E.; Huefner, J.; Weidenmueller, H. A.; Tepel, J. W. Phys. Lett.; 38B: No. 6, 349-53(20 Mar 1972).

Anomalies in excitation functions of the doubly isospin-forbidden reaction ^{89}Y(α,n) have been detected at energies near known isobaric analog resonances. They are interpreted in terms of isospin-breaking mechanisms. (auth)

26962 NEUTRON CAPTURE CROSS SECTIONS AT 25 keV. Rao, B. V. Thirumala; Rama Rao, J.; Kondaiah, E. (Andhra Univ., Waltair, India). J. Phys., A (London); 5: No. 3, 468-70 (Mar 1972).

The radiative capture cross sections for eight even–even nuclei in the mass region 80 < A < 160 were investigated using the activation method and gamma counting technique. The cross sections for the three isotopes ^{84}Kr, ^{110}Cd and ^{146}Nd are reported for the first time, and in the rest of the cases a comparison is made with previously reported values. The case of ^{115}In(n,γ)^{116m}In was reinvestigated, as there is a discrepancy between the values reported using beta and gamma counting methods. The present results are in better agreement with gamma counting values. (auth)

26963 TIME-DIFFERENTIAL OBSERVATION OF NMR BY PERTURBED ANGULAR CORRELATION. Braeuer, N.; Focke, B.; Lehmann, B.; (and others) (Freie Univ., Berlin. Hahn-Meitner-Institut fuer Kernforschung, Berlin). Phys. Lett.; 37B: No. 2, 186-8(15 Nov 1971).

The spin precession about the rf field vector $H_1(t)$ was observed time-differentially by means of the γ-angular correlation of the 120 μs state in ^{78}Br. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 25999, 26000, 26837, 26888, 26898, 26906, 26921, 26944, 26946, 26955, 26957, 26958, 26962, 27061, 27098, 27102, and 27338.

26964 (ANL–7869) PALLADIUM: FAST-NEUTRON TOTAL AND SCATTERING CROSS SECTIONS. Smith, A. B.; Lambropoulos, P.; Guenther, P. T.; Whalen, J. F. (Argonne National Lab., Ill.). Nov 1971. Contract W-31-109-eng-38. 37p. Dep. NTIS.

The neutron total and scattering cross sections of elemental palladium were experimentally studied. Total cross sections were measured from 0.1 to 1.5 MeV with resolutions of ~2 keV, and elastic- and inelastic-scattering cross sections were determined from incident neutron energies of 0.3 to 1.5 MeV. The inelastic neutron excitation of states at 320 ± 50, 390 ± 20, 440 ± 20, 500 ± 30, 570 ± 20, 830 ± 20, and 940 ± 25 keV was prominently observed. In addition, the excitation of states at 650 ± 25, 720 ± 25, 760 ± 25, and 1010 ± 50 keV was qualitatively and/or tentatively observed. An optical potential deduced from detailed comparisons of calculated and measured fast-neutron cross sections was descriptive of the present experimental results, of previously reported high-energy cross sections, and of the minimum in the l = 0 strength function in the region of A ~ 105. (auth)

26965 (INP–778) MEASUREMENTS OF THE ELASTIC SCATTERING CROSS-SECTION OF ALPHA PARTICLES ON THE HEAVY AND MEDIUM WEIGHT NUCLEI IN THE VICINITY OF THE COULOMB BARRIER IN A WIDE ANGULAR RANGE. Karcz, W.; Kluska, I.; Sanok, Z.; Szmider, J.; Szymakowski, J.; Wiktor, S.; Wolski, R. (Institute of Nuclear Physics, Krakow (Poland)). 1971. 38p. Dep. NTIS (U. S. Sales Only).

The measurements of differential cross sections of elastically scattered alpha particles with energies 23.5 and 27.7 MeV on Nb, Pd, Ag, In, Sn, Ta, Pt, Au, Pb and Bi targets, made of natural elements, were performed in a wide range of angles. The experimental procedure and the results are presented. It was observed that the oscillatory structure of $\sigma(\theta)/\sigma_R$ disappears continuously when energy is lowered from higher to lower values and approaches the Coulomb barrier. The slope of $\sigma(\theta)/\sigma_R$ and the cross-section values, obtained at backward angles, varies more rapidly with energy in the vicinity of the Coulomb barrier. (auth)

26966 (JINR–E6-6193) TWO-QUASIPARTICLE EXCITATION IN ^{146}Eu. Hagemann, U.; Neubert, W.; Peker, L. K.; Schulze, W.; Stary, F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1971. 16p. Dep. NTIS (U. S. Sales Only).

The decay of the two-particle isomeric state with 235 μs half-life was investigated by in-beam gamma-ray measurements at the Heavy Ion Cyclotron. Together with the ^{146}Gd ground-state decay-data the obtained level scheme leads to the conclusion that the multiplet splitting of the $p(d_{\frac{5}{2}})^{-1}\, n(f_{\frac{7}{2}})^1$ configuration is mainly caused by Wigner forces. (auth)

26967 (JINR–P3-6237) SPINS OF ^{147}Sm and ^{149}Sm NEUTRON RESONANCES. Karzhavina, E. N.; Kim Sec Su; Popov, A. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). Feb 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

Spins of ^{147}Sm and ^{149}Sm neutron resonances were measured in the region up to 400 eV by the method of γ-quantum multiplicity using a neutron spectrometer. Spins of 50 resonances of ^{147}Sm and 70 resonances of ^{149}Sm were determined. It is shown that the strength functions of ^{147}Sm and ^{149}Sm are independent of the spin, and the level density dependence on the spin agrees well with the theoretical predictions. (auth)

26968 (JINR–P6-6217) STUDY OF THE ^{135}Pr → ^{135}Ce DECAY. Arlt, R.; Beyer, G.; Morozov, V. A.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). Feb 1972. 24p. (In Russian). Dep. NTIS (U. S. Sales Only).

Gamma spectra, conversion electron spectra, and γ–γ coincidence spectra from the decay of ^{135}Pr ($T_{\frac{1}{2}}$ = 27 min) were measured. The lifetime of the first excited state of ^{135}Ce was measured as well. The measurements were made with the aid of mass-separated sources of the praseodymium fraction, obtained in chemical treatment. The decay scheme is constructed based on the experimental data. The levels of the neighboring nuclei are systematized. (auth)

26969 (OULNS–71-11) TWO-NEUTRON TRANSFER REACTIONS ON NUCLEI IN THE TRANSITIONAL REGION. Takemasa, T.; Sakagami, M.; Sano, M. (Osaka Univ. (Japan). Lab. of Nuclear Studies). [nd]. 7p. NTIS (U. S. Sales Only).

The possibility of coexistence of spherical and deformed states in samarium isotopes is explored by analyzing the experimental data of the two-neutron transfer reactions, and the amount of mixing of the coexisting states and their deformation parameters are determined. (auth)

26970 (RLO–1388-159) LIFETIME OF THE FIRST EXCITED STATE IN ^{96}Zr. Burch, D.; Russo, P.; Swanson, H.; Adelberger, E. G. (Washington Univ., Seattle. Dept. of Physics). [1971]. 9p. Dep. NTIS.

The reaction ^{96}Zr(p,p'e) was used to measure the lifetime of the 0_2^+ (1.59 MeV) state in ^{96}Zr through the observation of delayed coincidences between a pulsed proton beam and the E0 internal conversion electrons from its decay. The measured half-life is (38.0 ± 1.5) nsec. (auth)

26971 (RT/FI–(71)30) SPEC: A COMPUTER PROGRAMME FOR ANALYSIS OF GAMMA-RAY SPECTRA FROM RADIATIVE NUCLEON CAPTURE. Fabbri, F.; Longo, G.; Saporetti, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 25 Oct 1971. 45p. Dep. NTIS (U. S. Sales Only).

A description of the SPEC program, written for the IBM 360/75 computer in FORTRAN IV, is given. The code calculates γ-ray spectra, following the capture of nucleons by nuclei, on the basis of the direct and collective capture mechanisms. (auth)

26972 (RT/FI–(71)31) KISS: A FORTRAN CODE FOR QUADRUPOLE DIRECT RADIATIVE CAPTURE CROSS SECTION CALCULATION. Fabbri, F.; Longo, G.; Saporetti, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 25 Oct 1971. 36p. Dep. NTIS (U. S. Sales Only).

A description of the KISS code, written in FORTRAN IV for the IBM 360/75 computer, is given. The program calculates the quadrupole nucleon radiative capture cross section on the basis of "direct" capture theory. (3 figures, 1 table) (auth)

26973 MULTIPOLE ORDER PREDOMINATING IN RADIATIONAL TRANSITIONS WITH ENERGIES ≥2 m_0c^2 IN THE NUCLEI ^{114}Cd, ^{150}Sm, AND ^{158}Gd, EXCITED DURING THERMAL NEUTRON CAPTURE. Panin, Yu. N.; Pelekhov, V. I.; Ivanov, V. A. (Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1593-8(Aug 1971). (In Russian)

The spectra of positrons of internal conversion which were emitted by the nuclei ^{114}Cd, ^{150}Sm, and ^{158}Gd during thermal neutron capture were studied by means of a magnetic spectrometer with a target in a neutron beam. The positrons were in the energy range 0.5 to $(B_n - 2m_0c^2)$ MeV. The total number of internal conversion positrons per neutron capture was determined. After comparing the number of internal conversion positrons determined from the positron spectra and the γ ray spectra, it was concluded that type E1 transitions predominated during de-excitation of nuclei of ^{114}Cd, ^{150}Sm, and ^{158}Gd among transitions with energies ≥$2m_0c^2$. (tr-auth)

26974 α-DECAY OF THE RESONANT STATES OF ^{148}Sm. Vil'gel'm, I.; Popov, Yu. P.; Pshitula, M.; Rumi, R. F.; Stempin'ski, M. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1542-9(Aug 1971). (In Russian).

The spectra of eleven resonant states in the reaction ^{147}Sm(nα)^{144}Nd were analyzed. The distribution of the partial α-widths and the probabilities of α-particle emission with different orbital moments were examined. The effect of the structures of highly excited states on α-decay is discussed. (tr-auth)

26975 DECAY OF ^{139}Nd. Buttsev, V. S.; Vylov, Ts.; Kalinnikov, V. G.; Tikhonov, N. A.; Kherrmann, E. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1618-26(Aug 1971). (In Russian).

The radioisotope ^{139}Nd was prepared by exposing a gadolinium target to 660 MeV protons in a synchrocyclotron. The gamma radiation spectrum was determined with a Ge(Li) spectrometer. Energies, intensities, electron conversion data, and multipole orders and tabulated for ^{139*}Nd (5.53 hr), and for ^{139g}Nd (29.6 min). The complex decay scheme for ^{139*,g}Nd is graphically depicted. In 14.3% of the cases 5.5-hr state ^{139}Nd luminesces with a 231.5 keV γ-transition (type M4), and in the remaining cases it experiences $\epsilon + \beta$-decay. The maximum kinetic energy of the emitted electron is 1,170 ± 50 keV. (tr-auth)

26976 INVESTIGATIONS OF SHORT-LIVED ISOMERS OF ISOTOPES OF TERBIUM: ^{148}Tb, ^{149}Tb, ^{150}Tb, AND ^{152}Tb. Arl't, R.; Baier, G.; Kuznetsov, V. V.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1612-17(Aug 1971). (In Russian).

The short-lived isotopes of terbium were prepared by irradiating dysprosium with 680 MeV protons in a synchrocyclotron, and subsequently separating out the undesired products by chromatography. Other methods of preparation are also described. Partial decay schemes for ^{148}Tb, ^{149}Tb, ^{150}Tb, and ^{152}Tb, as well as ^{152*}Tb → ^{152}Gd in comparison to the excited levels of ^{154}Dy, are graphically depicted. (K.S.W.)

26977 INVESTIGATION OF THE DECAY OF ^{138}Nd AND ^{138g*}Pr. Afanas'ev, V. P.; Buttsev, V. S.; Gromova, I. I.; Kalinnikov, V. G.; Tikhonov, N. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 35: No. 8, 1603-11(Aug 1971). (In Russian).

The isotopes ^{138}Nd, ^{138g}Pr, and ^{138*}Pr were produced in proton spallation reactions of Gd (E_p = 660 MeV). A 2-g target was irradiated for 2 hr in the inner beam of a synchrocyclotron. Chemical and mass spectrograph separations were necessary for the γ ray work, which was conducted with a spectrometer with a Ge(Li) detector. Inner electron conversion studies were performed with a magnetic β-spectrometer with a double focused beam. Energies and intensities of the γ radiation and conversion electrons for ^{138}Nd in equilibrium with ^{138}Pr (1.5 min) are tabulated with the determined multipole order. A similar tabulation is provided for ^{138}Pr ($T_{\frac{1}{2}}$ = 2.1 hr). The decay schemes for ^{138}Nd → ^{138}Pr, for ^{138g}Pr → ^{138}Ce, and for ^{138*}Pr → ^{138}Ce are graphically depicted. (K.S.W.)

26978 CONVERSION ELECTRON SPECTRUM OF ^{131}I. Illes, F.; Juhasz, S.; Ujhelyi, Cs. (Inst. of Nuclear Research, Debrecen, Hungary). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1599-1602(Aug 1971). (In Russian).

A portion of the decay scheme ^{131}I → ^{131}Xe was studied using a 20 μCi sample of ^{131}I which had been deposited chemically on a 0.1 mm Ag wire. A conversion electron spectrum was determined with a β-spectrograph with a permanent magnet and a trajectory with a maximum radius of 75 cm. The 637 keV transition data and the 643 keV transition data from ^{131}Xe were compared with those from other workers and with calculated values. (K.S.W.)

26979 RESONANCE SCATTERING OF γ QUANTA BY NUCLEI ^{105}Pd AND ^{111}Cd. Shubnyi, Yu. K.; Lysikov, Yu. A. (Inst. of Nuclear Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1651-2(Aug 1971). (In Russian).

The lifetimes of the excited states of ^{105}Pd and ^{111}Cd with energies 0.319 and 0.342 MeV, respectively, were studied by means of nuclear resonance scattering. The sources of γ rays were ^{105}Rh ($T_{\frac{1}{2}}$ = 36.5 hr) and ^{111}Ag ($T_{\frac{1}{2}}$ = 7.6 dn). The differential resonance scattering cross section was determined as a function of the temperature of the source; a temperature of 1,000 to 1,400°C effectively increases the cross section because of Doppler broadening of the emission lines. (K.S.W.)

26980 REACTION SPECTROSCOPY WITH EVEN TIN ISOTOPES. Iwe, H.; Reif, R.; Riedel, C. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys.; A183: No. 1, 105-25(1972).

The two-particle transfer reactions ^{116,118}Sn(t,p) and the inelastic scattering of 55 MeV protons from ^{116}Sn and 16 MeV protons from ^{116,118,120}Sn are analyzed for various transitions to collective and non-collective states in the final nucleus using DWBA. Form factors have been calculated with wave functions containing two-quasiparticle excitations of neutrons in open and closed shells as well as 1p-1h transitions from closed proton shells. In the inelastic scattering, generally a Serber-type Gaussian effective interaction was inserted. The results are compared with those obtained on the assumption of two-quasiparticle excitations in a restricted configuration space only. For both types of reaction, reasonable agreement with experimental data is obtained for the angular distribution. In the (t,p) reaction the measured and calculated relative cross sections agree within a factor of two. For the inelastic scattering, apart from relative cross sections the mass dependence of the collective excitations and the influence of four-quasiparticle excitations have been examined. The transition to the collective 2^+ level in ^{116}Sn was calculated with the proton component of the wave function corrected according to electromagnetic measurements. From inelastic scattering it follows that the transitions to negative-parity states especially are not described satisfactorily by the wave functions used. Cross sections for unobserved higher excited levels have been estimated. (auth)

26981 STUDY OF THE LEVEL SCHEME OF ^{117}In VIA PROTON TRANSFER REACTIONS. Harar, S.; Horoshko, R. N. (Univ. of Rochester, N. Y.). Nucl. Phys.; A183: No. 1, 161-72(1972).

The (^{3}He,d) and (α,t) reactions on ^{116}Cd have been used to study levels in ^{117}In up to 2.8 MeV excitation. The measurements were performed at the ^{3}He and α-particle bombarding energies of 27 and 25.5 MeV, respectively, using a magnetic spectrograph. Deuteron angular distributions were compared with the distorted-wave Born approximation predictions to obtain angular momentum transfer and spectroscopic factors. Tritons were recorded at only three angles. Present results show significant configuration mixing of the proton wave function in the ^{116}Cd ground state. The low-lying positive-parity levels of ^{117}In are discussed in the framework of the particle core coupling model and the rotational model. (auth)

26982 EXPERIMENTAL TEST OF CONVERSION COEFFICIENT RATIOS FOR M-, N- AND O-SHELL ELECTRONS. Dragoun, O. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Martin, B.; Merkert, D.; Vinduska, M. Nucl. Phys.; A183: No. 2, 390-400(1972).

Relative conversion-line intensities have been measured for five E2 transitions of energies from 81 to 412 keV in nuclei with Z ranging from 55 to 80 using the iron-free $\frac{1}{2}\pi\sqrt{13}$ β-ray spectrometer. The results for M-, N- and O-shells were found to agree with the calculations where screening is taken into account. The atomic screening and finite nuclear size effects in internal conversion of the N-subshell electrons were investigated. Two previously measured conversion electron spectra were analyzed with four different computer codes and the consistency of the results was examined. (auth)

26983 OPTICAL-MODEL ANALYSIS OF $^{92\ 94\ 96\ 100}$Mo(p,p) FOR 20, 30, AND 50 MeV INCIDENT PROTON ENERGIES. Sinah, B. C. (King's Coll., London); Edwards, V. R. W.; Burge, E. J.; Tait, W. H. Nucl. Phys.; A183: No. 2, 401-16(1972).

Proton elastic scattering cross sections and polarizations have been measured for several isotopes of molybdenum at 20, 30 and 50 MeV and analyzed in terms of the regular optical model, the reformulated optical model and a version of the regular model which contains a real central Saxon-Woods derivative term. New methods are developed for determining the symmetry potential, and the value of employing density-dependent forces in reformulated-model calculations is demonstrated. (auth)

26984 GROUND STATE HYPERFINE STRUCTURES AND NUCLEAR QUADRUPOLE MOMENTS OF ^{95}Mo AND ^{97}Mo. Pendlebury, J. M.; Ring, D. B. (Univ. of Sussex, Brighton, Eng.). J. Phys., B (London); 5: No. 2, 386-96(Feb 1972).

Hyperfine structure intervals in the $4d^55s\ ^7S_3$ atomic ground state of ^{95}Mo and ^{97}Mo were measured by the methods of atomic beam magnetic resonance. The derived values for the hyperfine interaction constants are: A(^{95}Mo) = −208.5790(20) MHz, B(^{95}Mo) = +0.042(12) MHz, A(^{97}Mo) = −212.9781(20) MHz, B(^{97}Mo) = −0.085 (14) MHz, g_J(^{98}Mo) = 2.000 55(4) and $^{95}\Delta^{97}$ = −0.01(1)%. A theory of quadrupole interactions in half filled atomic shells, known to be successful in several other cases, was used to obtain the nuclear quadrupole moments from the B values with the results Q(^{95}Mo) = −0.075(25) barns and Q(^{97}Mo) = +0.15(4) barns. The atomic beam was produced by collimating atoms evaporating from a 2 mm diameter molten ball of molybdenum suspended on the end of a 0.3 mm diameter molybdenum wire. (auth) (UK)

26985 MOESSBAUER SCATTERING IN ^{141}Pr. Groves, Joel Lee. Urbana, Ill.; Univ. of Illinois (1971). 93p. University Microfilms Order No. 72-6941.

Thesis.

A series of Moessbauer scattering experiments was completed on ^{141}Pr using an axially symmetric backscattering arrangement. From the relative isomer shifts between Pr^{+4} and Pr^{+3} compounds, the mean-square charge radius of the 145-keV excited state of the ^{141}Pr nucleus is estimated to be $(7.1 \pm 2.1) \times 10^{-29}$ cm^2. PrO_2 exhibits ordered magnetic behavior below 13°K. The hyperfine fields from the electronic ground states of a Pr^{+4} ion in a magnetic, cubic crystal were estimated, and the observed values of the effective fields were compared with the calculated fields. Best agreement was found when it was assumed that the exchange field was directed toward a nearest neighbor Pr^{+4} ion. $(3.10 \pm .17)\mu_N$ was obtained for the magnetic moment of the 145-keV, spin $\frac{7}{2}$ level of $^{141}_{59}$Pr. (Diss. Abstr. Int., B)

26986 (^{18}O,^{16}O) REACTION ON Mo ISOTOPES AT ENERGIES ABOVE THE COULOMB BARRIER. Chasman, C.; Cochavi, S.;

LeVine, M. J.; Schwarzschild, A. Z. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett.; 28: No. 13, 843-6(27 Mar 1972).

The two-neutron-transfer reaction (^{18}O,^{16}O) to the ground and first 2^+ states of $^{94,96,98,100}Mo$ was measured 55, 60, 70, and 77 MeV projectile energy. Angular distributions and absolute cross sections are compared with the theory of Dar, which accounts for a large part of the variation of cross section with target mass number, energy, and the observed angular distributions. Evidence for multiple processes is exhibited in the excited-state cross sections. (auth)

26987 SUBSHELL CONVERSION-LINE INTENSITY RATIOS FOR SOME PURE TRANSITIONS. Brenner, D. S. (Brookhaven National Lab., Upton, N. Y. Clark Univ., Worcester, Mass.); Perlman, M. L. Nucl. Phys.; A181: No. 1, 207-16(1972).

For a number of "normal" electromagnetic transitions, either necessarily pure or judged to be essentially pure, L- and M-subshell internal conversion ratios were measured and compared with ratios obtained from the Hager and Seltzer theoretical calculations. In addition, data available in the literature were also used in these comparisons. A range of Z-values and energies and several multipole orders were included. There appears to be no real disagreement between theory and experiment. A possible source of systematic error in high-resolution internal conversion spectrometry is briefly discussed; and a simple accurate method for energy interpolation of theoretical coefficients is described. (auth)

26988 STUDY OF THE NATURE OF NUCLEAR STATES USING INELASTIC SCATTERING OF PROTONS AND DEUTERONS. Kabakova, N. E.; Korbetskii, E. V.; Nemets, O. F.; Sokolov, L. S. (Kiev State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1736-41(Aug 1971). (In Russian).

A comparison was made of calculated differential cross sections of inelastic scattering of 13 MeV protons by ^{114}Cd. An analogous analysis of elastic and inelastic scattering of 13.6 MeV deuterons by nuclei ^{60}Ni and ^{118}Sn was conducted. Such calculations have been performed within the frameworks of the vibrational and Davydov–Chaban models. It was possible to discriminate in the cases examined between the two models provided that the reference curves of elastic scattering accurately depict the experimental cross sections. (K.S.W.)

26989 INNER CONVERSION OF SOME LOW RADIATIONAL TRANSITIONS OF ^{144}Nd. Groshev, L. V.; Pelekhov, V. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 786-90(Apr 1971). (In Russian).

The spectrum of internal electron conversion of ^{144}Nd which is emitted upon the capture of thermal neutrons by the isotope ^{143}Nd (enrichment 94.6%) was determined over the interval of electron energies 0.6 to 1.7 MeV with a resolution of 0.6% with a magnetic spectrometer. Thirteen radiational transitions were observed, the majority of which were placed in the level scheme of this nucleus. (tr-auth)

26990 GAMMA RADIATION OF ^{106}Ag. Basina, A. S.; Grigor'ev, E. P.; Kuznetsov, R. A. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 791-3(Apr 1971). (In Russian).

The reaction $^{107}Ag(\gamma,n)^{106}Ag$ was conducted by irradiating 99.99% pure Ag of natural isotopic composition with betatron bremsstrahlung. The relative intensities of gamma quanta emitted by ^{106}Ag ($T_{1/2}$ = 24.7 min) are tabulated, and a decay scheme for this isotope is proposed. (K.S.W.)

26991 USE OF A VIBRATING MODEL AND THE DAVYDOV–CHABAN MODEL FOR DESCRIBING THE LOW-LYING EXCITED STATES OF THE NUCLEI $^{112\ 114}Cd$, ^{110}Pd. Kabakova, N. E.; Korbetskii, E. V.; Nemets, O. F.; Sokolov, L. S. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 841-6(Apr 1971). (In Russian).

The low-lying states of $^{112,114}Cd$ and ^{110}Pd form a triplet (I^π = 0^+, 2^+, 4^+), which may be examined with respect both to a two-phonon vibrating model and to the components of rotational-vibrational spectrum of the Davydov–Chaban model. A comparison is made of the experimentally measured differential inelastic proton scattering cross sections at an energy of 13 MeV with the corresponding calculated values on the basis of the models referred to. Both models satisfactorily explain the transition between the ground and the first excited states of the nuclei, but are not completely successful in describing the electromagnetic transitions for higher excited states. (K.S.W.)

26992 NATURE OF ISOMERIC STATES OF ^{135}Te AND ^{133}Sn. Peker, L. K. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 855(Apr 1971). (In Russian).

The observations of J. W. Grueter et al. (1970) of a γ-transition at 321 keV in ^{135}Te ($T_{1/2}$ = 0.7 μsec) and of an isomer with $T_{1/2}$ = 0.5 μsec in ^{131}Sn, ^{132}Sn, or ^{133}Sn are discussed in the light of multipole order of transitions. The existence of such short-lived isomers in nuclei of ^{131}Sn or ^{132}Sn is improbable, and is attributed to ^{133}Sn. (K.S.W.)

26993 SPIN OF THE ISOMERIC STATE OF ^{112}In. Peker, L. K. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 858(Apr 1971). (In Russian).

The isotope $^{112}In_{63}$ differs from the other odd-odd isotopes of In by possessing an isomeric transition multipole order not of E4 but of M3. This characteristic derives from the fact that as the neutron number in the In nucleus increases from 59 to 69, the single-particle neutron level $d_{5/2}$ is raised but the levels $s_{1/2}$, $h_{11/2}$, and $d_{3/2}$ are lowered. The basic and isomeric states of odd-odd isotopes of $^{108,110}In$ are discussed, and level schemes of individual isotopes are depicted. (K.S.W.)

26994 INFLUENCE OF THE SOURCE THICKNESS ON $\beta\gamma_{cp}$ CORRELATION EXPERIMENTS. Schmidt, V.; Zitzler, I. (Institut fuer Kernphysik, Muenster, Ger.). Nucl. Instrum. Methods; 99: No. 2, 183-7(1972). (In German).

A method is described which allows a correction for the influence of thick sources on $\beta-\gamma_{cp}$ correlation measurements. It takes into account the following processes of the β particles: elastic scattering, energy loss, absorption, backscattering on the detector, finite resolution of the detector and the electronics, and backscattering in the source and in the backing foil. (22 references) (auth)

26995 DECAY OF ^{114}Ag. Wallace, G. (Inst. of Nuclear Sciences, Lower Hutt, N. Z.); McCallum, G. J.; Chapman, N. G. Nucl. Phys.; A184: No. 1, 166-74(1972).

The decay scheme of ^{114}Ag was studied with Ge(Li) γ-ray detectors and a plastic β-ray detector. Of the 11 γ rays observed in the decay, 9 were incorporated into the ^{114}Cd level structure previously determined by conversion electron measurements made on the products from the $^{113}Cd(n,\gamma)^{114}Cd$ reaction. The end-point energy of the β decay was determined as 4.90 ± 0.26 MeV; no branching was evident in the β spectrum. A decay scheme is proposed for which the β branching was deduced from the measured γ-ray yield and an extrapolated cross-section value for the $^{114}Cd(n,p)^{114}Ag$ reaction. The ^{114}Ag half-life was determined as 4.52 ± 0.07 s; a search for a previously reported isomeric state of ^{114}Ag was unsuccessful. (5 figures, 1 table) (auth)

26996 INFLUENCE OF THE ANGULAR DIMENSIONS OF A DETECTOR ON THE ERROR IN DETERMINING CERTAIN KINEMATIC CHARACTERISTICS. Potetyunko, G. N. At. Energ. (USSR); 32: No. 1, 72-3(Jan 1972). (In Russian).

Nomograms are presented for finding the relative error in the value of the energy of the product of a nuclear reaction of the binary type and the differential effective cross section for a nuclear reaction of the binary type given the angle of detection of the outgoing particle. (2 figures) (K.S.W.)

26997 BETA SPECTRUM OF ^{140}La. Nagarajan, T. (Univ. of Madras); Ravindranath, M.; Reddy, K. Venkata. Nuovo Cim.; 8A: No. 2, 305-18(21 Mar 1972).

The β spectrum of ^{140}La was analyzed with a thoroughly tested Slatis–Siegbahn β-ray spectrometer equipped with a well-type plastic whose counting efficiency is unity down to 50 keV. The F.K. analysis in which the outer group is properly shape-corrected yields the following β groups: (2164 ± 2) (8%), (1680 ± 7) (18%), (1365 ± 10) (46%), (1150 ± 5) (19%), (857 ± 15) (4%), and (510 ± 20) (5%) keV. The outer β group with end point 2164 keV has "modified B_{ij} shape" with D = 2.3 ± 2, indicative of complete cancellation in the matrix element combination Y. The experimental shape supports the $(g_{7/2})^2_{I=2}$ proton configuration to the 2^+ first excited level of ^{140}Ce, but a quantitative agreement is possible only when the CVC condition is relaxed. (7 figures, 3 tables) (auth)

26998 INTERNAL CONVERSION AT TRANSITIONS OF HIGHER ENERGY IN DECAY ^{131}I. Varga, D.; Koever, A.; Berenyi, D.; Lakatos, T. (Inst. of Nuclear Research, Debrecen, Hungary). Acta Phys. Acad. Sci. Hung.; 30: No. 2, 167-74 (1971).

The higher-energy regions of gamma rays (from 480 to 810 keV) and conversion electrons (from 570 to 760 keV) were studied with a 20-cm^3 Ge(Li) and a 3-mm deep Si(Li) semiconductor spectrometer, respectively. For the conversion coefficients and for their ratio, $\alpha_K = (3.6 \pm 0.5) \times 10^{-3}$ and $K/L = 5.3 \pm 1.6$ were obtained for the 636.3-keV transition and $\alpha_K = (3.9 \pm 0.6) \times 10^{-3}$ and $K/L = 4.7 \pm 1.4$ for the 722.9-keV transition. On the basis of these and some other published data, the $^5/_2{}^+$ assignment for the 722.9-keV level and the $^7/_2{}^+$ one for the 636.3-keV level seem to be the most probable. (4 figures, 3 tables) (auth)

26999 SECOND ORDER PAIRING PHASE TRANSITION IN THE Sn-ISOTOPES: COMPETITION BETWEEN PAIRING AND SHELL EFFECTS. Broglia, R. A. (State Univ. of New York, Stony Brook. Univ. of Copenhagen); Kunz, P. D.; Nilsson, B. Phys. Lett.; 38B: No. 6, 383-8(20 Mar 1972).

The L = 0 transitions observed in the ^{A}Sn(t,p) and ^{A}Sn(p,t) (A even) reactions are analyzed in the framework of the pairing vibrational model. The strong variations of the cross section associated with the $J^{\pi} = 0^{+}$ excited states are shown to provide strong evidence for the existence of an incomplete pairing phase transition taking place around masses A = 116 and A = 118. (auth)

27000 TOTAL PARTICLE PARAMETER OF THE 212 keV TRANSITION IN ^{121}Te. Edvardson, L. O.; Westerberg, L.; Madueme, G. C.; Samuelsson, L. (Univ. of Uppsala). Phys. Scr.; 4: No. 1-2, 45-7(1971).

The conversion coefficient of the 212 keV $3/2^{+}$-$1/2^{+}$ transition in the odd neutron nucleus ^{121}Te has been determined by e-e coincidence measurements, giving $\alpha_K = 0.0768(17)$, and the total particle parameter, $B_{2K} = -0.22(11)$, by e-e and e-γ directional correlations. These values give the multipole mixing ratio $\delta(E2/M1) = -0.226(8)$ and little or no anomalous M1 conversion, $\lambda = -0.7(17)$. The λ-value is compared with a theoretical estimate. (auth) (Sweden)

27001 EXPERIMENTAL STUDY OF THE ^{149}Sm(n,α) REACTION WITH THERMAL NEUTRONS. Bischof, J. (Nuclear Research Inst., Rez, Czech.); Dlouhy, Z.; Kvitek, J.; Popov, Yu. P. Czech. J. Phys.; 22: No. 1, 9-17(1972).

The cross section of the ^{149}Sm(n,α) reaction for several alpha transitions was measured. Using an arrangement where only the target is situated in the beam while the detector is placed in some distance aside, the influence of a high background has been successfully eliminated. A detailed analysis of the background has been performed. The obtained resolution in the alpha particle energy (FWHM = 65 keV) makes it possible to distinguish seven transitions for which average cross sections for the thermal neutron spectrum with T = 400°K have been evaluated. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 25661, 26962, 26965, 26969, 26971–26973, 26982, 26987, 26994, 26996, 27061, 27068, and 27076.

27002 (JINR-P4-6242) ANALYSIS OF M1-INTERNUCLEAR CONVERSION ON THE BASIS OF THE DEFORMED SAXON-WOODS POTENTIAL. Feresin, A. P.; Schulz, H. (Joint Inst. for Nuclear Research Dubna (USSR). Lab. of Theoretical Physics). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

On the basis of the deformed Saxon–Woods potential penetration matrix elements of the internuclear conversion are calculated for 20 M1-transitions in the rare earth region. The experimental data for the anomalous M1-transitions relative to the ICC with $\Delta K = 1$ agree well with the theoretically predicted results. For transitions within a rotational band structure effects in the ICC are not larger than 10%. (auth)

27003 (JINR-P4-6280) INVERSE PROBLEM OF PAIRING FOR ^{169}Yb NUCLEUS. Aleksandrov, L.; Karadzhov, D.; Mikhailov, I. N.; Nadzhakov, E.; Khodzhaev, G. (Joint Inst. for Nuclear Research, Dubna (USSR)). Feb 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

Based on the system of equations obtained previously (P4-6279 JINR, 1972), the inverse problem is solved for finding the parameters of the rotor Hamiltonian for ^{169}Yb. The numerical solution was carried out by the standard program AUTORE. The behavior of the gap parameter in the ground rotational band of ^{169}Yb is found as well as its value for the experimentally known bandheads in this nucleus. The influence of the core polarization on the value of the quantities sought is studied. (auth)

27004 (LA-tr-72-2(RD)) INVESTIGATION CONCERNING THE INTERACTION OF HIGH ENERGY PROTONS WITH TANTALUM NUCLEI TO FORM LANTHANIDE RECOIL PRODUCTS. I. LANTHANIDE PRODUCTION CROSS SECTIONS AT PROTON ENERGIES OF 580 MeV. Neidhart, B.; Baechmann, K. Translated by A. E. Norris (Los Alamos Scientific Lab., N. Mex.), from J. Inorg. Nucl. Chem.; 33: 2751-61(1971). 15p. Dep. NTIS.

Tantalum was irradiated with 580-MeV protons and the rare earth elements were separated. The independent or cumulative cross sections for the formation of about 30 nuclides of the lanthanides are determined. The experimentally obtained σ values are compared with theoretical σ values calculated by using the Rudstam formulas. By variation of the different parameters the agreement is very satisfying. Thus it can be shown that the Rudstam formulas, which until now were tested only for nuclides with $Z \leq 47$, can be used for nuclides with high Z as well. A dependence on the Z of the target can be demonstrated for two parameters of the spallation formula. The agreement with the Rudstam formulas proves that the lanthanides at 580 MeV proton energy are formed by a single mechanism. These products are very likely formed by spallation. (auth)

27005 DE-EXCITATION OF EVEN–ODD NUCLEI OF SAMARIUM AND GADOLINIUM FOLLOWING THERMAL NEUTRON CAPTURE. Groshev, L. V.; Demidov, A. M.; Sokolovskii, L. L. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1644-50(Aug 1971). (In Russian).

The gamma ray spectra resulting from thermal neutron capture by nuclei ^{154}Sm and ^{156,158,160}Gd were studied. Samples which contained the indicated isotopes in a 99.2 to 95.5% enrichment were irradiated in a neutron flux which would tend to burn out impurities. Level schemes for ^{155}Sm, and ^{157,159,161}Gd are shown. (K.S.W.)

27006 INNER CONVERSION OF ELECTRICAL DIPOLE TRANSITIONS IN ^{175}Lu. Grigor'ev, V. N.; Sergeenkov, Yu. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1638-43(Aug 1971). (In Russian).

The absolute values of coefficients of internal conversion for 396.3, 282.5, and 144.8 keV E1 transitions in ^{175}Lu were measured by determining the relative intensities of γ-quanta and inner conversion electrons. The sample of ^{175}Lu was obtained through the decay of enriched ^{175}Yb, which was contained in irradiated ytterbium oxide in a neutron flux of 10^{14} n cm^{-1} sec^{-1}. The intranuclear parameters of E1 transitions in ^{175}Lu are tabulated and discussed. (K.S.W.)

27007 EXCITED STATES OF ^{182}W WITH HIGH SPINS. Galan, P. (Physics Inst., Bratislava); Galanova, T.; Beis, M. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1627-37(Aug 1971). (In Russian).

Measurements were conducted with ^{182}Re which was prepared by two methods: 660 MeV protons in ^{197}Au(p,5p11n)^{182}Re, and 120 MeV protons in $^{(182+x-1)}$W(p,xn)^{182}Re. Energies and relative intensities of the γ rays, and multipole orders are tabulated for ^{182}Re. Gamma ray coincidence data in the region $E_\gamma < 350$ keV and $E_\gamma > 800$ keV are also tabulated. The decay scheme for the decay ^{182}Re → ^{182}W is graphically presented and discussed. (K.S.W.)

27008 DECAY ^{189}Pt → ^{189}Ir. Plainer, Z.; Beis, M.; Prokhazka, I.; (and others) (Inst. of Nuclear Research, Prague. Karlova Univ., Prague). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1569-74(Aug 1971). (In Russian).

The ^{189}Ir states, excited by the decay of ^{189}Pt ($T_{\frac{1}{2}} = 10.89$ h), were studied. New insights were obtained into γ-radiation, $\gamma\gamma$-coincidence, conversion electrons, and the positron spectrum of ^{189}Pt. Of 101 γ-transitions, 58 were identified for the first time. The energy of the decay ^{189}Pt → ^{189}Ir, determined by β^{+}-spectra, was 2,225 keV. A total of 75 transitions are mapped in the decay scheme, amounting to 97% of the decay intensity. (tr-auth)

27009 EXCITED STATES OF ^{187}Re RESULTING FROM THE DECAY OF ^{187}W. Brabets, V.; Maly, L.; Vobetski, M. (Inst. of Nuclear Research, Prague). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1562-8(Aug 1971). (In Russian).

The γ spectrum and conversion electron spectrum of ^{187}W were studied with the aid of a double-focusing β-spectrometer with a γ-spectrometer with a Ge(Li)-detector. The excited states of ^{187}Re were interpreted on the basis of the Nilsson model, allowing for the Coriolis interaction. It was thus possible to explain the bulk of experimental data by γ-transitions. This approach failed to agree with the experimental values only for transitions at rotational band levels at states $1/2^{+}$ [411]. (tr-auth)

27010 STUDY OF THE ODD-A RHENIUM ISOTOPES: ^{179}Re AND ^{177}Re. Leigh, J. R. (Univ. of California, Berkeley); Newton, J. O.; Ellis, L. A.; Evans, M. C.; Emmott, M. J. Nucl. Phys.; A183: No. 1, 177-96(1972).

Gamma-rays following ^{172}Yb(^{11}B,4n)^{179}Re and ^{169}Tm(^{12}C,4n)^{177}Re reactions have been studied with Ge(Li) detectors. Rotational bands based on the $1/2^{-}$[541], $1/2^{+}$[402] and $9/2^{-}$[514] states have been populated. A pronounced variation in the energies of the quasiparticle levels is apparent although the quadrupole deformation of the isotopes below mass 183 is expected to be fairly constant. It is suggested that the variation is related to the changing hexadecapole moments of these nuclei. (auth)

27011 TWO-NEUTRON TRANSFER REACTIONS ON NUCLEI IN THE TRANSITIONAL REGION. Takemasa, T.; Sakagami, M.; Sano, M. (Osaka Univ.). Phys. Lett.; 37B: No. 5, 473-6(27 Dec 1971).

The possibility of coexistence of spherical and deformed states in samarium isotopes is explored by analyzing the experimental data of the two-neutron-transfer reactions, and the amount of mixing of the coexisting states and their deformation parameters are determined. (auth)

27012 INTERACTION OF HIGH-ENERGY PROTONS WITH TANTALUM NUCLEI. II. KINETIC ENERGIES AND EXCITA-

TION ENERGIES. Trabitzsch, U.; Baechmann, K. (Technische Hochschule, Darmstadt, Ger.). Radiochim. Acta; 16: No. 3-4, 129-38(Dec 1971). (In German).

The thick target and thick catcher method was employed to determine the recoil properties of some isotopes of rubidium, strontium, yttrium and zirconium produced in the interaction of tantalum with 580 MeV and 19 GeV protons. The mean kinetic energies of these products at 580 MeV proton energy are 60 MeV on the average and change by about 3 MeV per unit of charge within one isobar series. With 19 GeV proton energy they are 17 MeV on the average, changing by about 2 MeV per unit of charge within one isobar series. The excitation energies for the formation of the products at the two proton energies were calculated. For 19 GeV proton energy, a lower excitation energy resulted than for 580 MeV. This gives rise to the conclusion that the equation used for calculation is no longer valid at the higher energy of bombardment. The results of this work show that the products of mean mass are produced by normal fission at 580 MeV proton energy and probably by several processes (fission of residual nuclei, spallation, fragmentation) at 19 GeV proton energy. (auth)

27013 COLLECTIVE STATES IN ^{151}Sm. Nelson, D. E.; Burke, D. G.; Cook, W. B.; Waddington, J. C. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 49: No. 24, 3166-73(15 Dec 1971).

Inelastic deuteron scattering experiments with a target of ^{151}Sm were carried out with bombarding energies of 5 MeV and 12 MeV. The scattered deuterons were analyzed with a magnetic spectrograph and B(E2) values for the states populated were extracted from the ratios of inelastic to elastic cross sections. The gamma rays following Coulomb excitation of ^{151}Sm by 50 MeV ^{35}Cl ions were also studied with Ge(Li) detectors. Levels at 65.8 keV, 168.4 keV, and 295.1 keV were populated with B(E2) values of 0.80 $e^2(barn)^2$, 0.15 $e^2(barn)^2$, and 0.46 $e^2(barn)^2$ respectively. If it is assumed that the strong-coupling model is appropriate and that the level at 65.8 keV is the first excited member of a rotational band based on the I = $5/2$ ground state, the measured B(E2) value corresponds to a deformation of $\beta = 0.21$. It must be noted, however, that the observed states do not satisfy the properties expected for a well-ordered ground-state rotational band. (auth) (Canada)

27014 NEW APPROACH TO PERTURBED γ-RAY ANGULAR DISTRIBUTIONS FROM HEAVY NUCLEI RECOILING INTO VACUUM. Brenn, R. (Univ., Freiburg i. B.); Spehl, H.; Weckherlin, A.; Steadman, S. G. Phys. Rev. Lett.; 28: No. 14, 929-32(3 Apr 1972).

Time-differential attenuation coefficients of the γ-ray angular distribution of Coulomb-excited Hf nuclei recoiling into vacuum were measured using a plunger technique. The data were interpreted in terms of a new model, which assumes a stochastic process with Gaussian probability distribution of the perturbing magnetic field strengths and arbitrary correlation times. Reasonable fits to all existing applicable measurements are obtained with a correlation time considerably larger than previously assumed. (auth)

27015 MIXING OF COMPONENTS WITH $\Delta N = \pm 2$ IN DEFORMED NUCLEI WITH ODD NUMBER OF NEUTRONS. Gareev, F. A.; Solov'ev, V. G.; Fedotov, S. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 14: No. 6, 1165-73 (Dec 1971). (In Russian).

$\Delta N = \pm 2$ mixing in a number of Sm, Gd, and Dy isotopes with an odd number of neutrons is studied in terms of a model accounting for superconducting pair correlations and quasi-particle interactions with phonons and using one-particle energies and wave functions of the Saxon–Woods potential. It is shown that at deformations $\beta_{20} = 0.30$ to 0.33 and $\beta_{40} = 0.04$ there is a strong mixing of the following pairs of states: $1/2^+[400]$, $1/2^+[660]$ and $3/2^+[402]$, $3/2^+[651]$. The results of the calculations of energies of these states and of the components of their wave functions with N = 4 and N = 6 are in reasonable agreement with corresponding experimental data. It is shown that the interactions of quasi-particles with phonons lead to a considerable rise of interval in β_{20}, where $\Delta N = \pm 2$ mixing occurs, as compared to the one-particle model. (1 figure, 3 tables) (auth)

27016 EXCITED STATES OF DEFORMED NUCLEI WITH 93, 95, AND 97 NEUTRONS 4. THE DECAY ^{167}Lu → ^{167}Yb. Abdurazakov, A. A.; Gromov, K. Ya.; Zvol'ska, V.; Islamov, T. A.; Shtrusnyi, Kh. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 698-706(Apr 1971). (In Russian).

A Ta target was irradiated with 680 MeV protons in a synchrocyclotron in order to produce radioactive ^{167}Lu needed for this decay study, although four other Lu isotopes and daughter products were also formed. Experimental and theoretical values of absolute and relative coefficients of internal conversion were compared for the γ-transitions of ^{167}Lu, and the decay scheme of ^{167}Lu was prepared. (K.S.W.)

27017 DECAY OF 105-MINUTE ^{181}Os. Akhmadzhanov, A. I.; Broda, R.; Valyus, V.; Zvol'ski, I.; Molnar, I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 725-38(Apr 1971). (In Russian).

The spectra of γ radiation, conversion electrons, and $\gamma\gamma$-coincidences of the 105-minute ^{181}Os were studied. It is suggested that part of the activity previously attributed to the 105-minute state belongs to the isomeric (2.7-minute) state of ^{181}Os. The decay scheme of the isotope is discussed, and a series of new levels are introduced. The lifetime of the 356.7-keV level was 96 ± 4 nsec. (tr-auth)

27018 NON-ROTATIONAL STATES FOR DEFORMED NUCLEI WITH ODD NEUTRON NUMBER IN THE REGION $153 \leq A \leq 175$. Malov, L. A.; Solov'ev, V. G.; Fedotov, S. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 747-55(Apr 1971). (In Russian).

Nuclear structure for odd number of neutrons was studied in the interval $153 \leq A \leq 175$, and particularly for nuclei for which previously calculated spectra were lacking. For given values of energy and K^π assignments, the detailed structures are tabulated for ^{153}Sm, ^{155}Sm, ^{157}Gd, ^{159}Gd, ^{161}Gd, ^{159}Dy, ^{161}Dy, ^{169}Er, ^{171}Er, ^{167}Yb, ^{173}Hf, and ^{175}Hf. (K.S.W.)

27019 POSITRONS OF PAIR CONVERSION IN TRANSITIONS OF ^{166}Er. Belyaev, B. N.; Vasilenko, S. S.; Gvozdev, V. S. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 770-3(Apr 1971). (In Russian).

A study of the positron spectrum of pair conversion in ^{166}Er was conducted in a magnetic spectrometer. The ratio of the probabilities of E0-transition (1,460 keV), and E2-conversion (1,380 keV) was $X(E0_\gamma\ 1{,}460/E2_\gamma\ 1{,}380) = 0.05 \pm 0.01$. This value is a characteristic of the natural 0^+-excitation, and may be interpreted as excitation connected with β-vibrations and spin-quadrupole interaction. (tr-auth)

27020 HALF-LIFE MEASUREMENT OF SEVERAL SHORT-LIVED NUCLEAR ISOMERS. Johnson, W. T. K. (American Univ., Washington, D. C.); Dick, C. E. Nucl. Instrum. Methods; 99: No. 2, 221-6(1972).

Bremsstrahlung produced by 3.5-MeV electrons incident on a platinum target was used to populate nuclear isomers in several nuclei through excitation of higher-lying states. A shuttle was constructed to transport targets of natural isotopic abundance from an irradiation position to a measured position. Other than a low background the activity measured was due entirely to the isomeric decay. The measured half-lives in seconds are as follows: ^{77m}Se, 17.58 ± 0.12; ^{79m}Br, 4.97 ± 0.10; ^{167m}Er; 2.28 ± 0.03; ^{179m}Hf, 18.77 ± 0.07; ^{183m}W, 5.56 ± 0.25; ^{191m}Ir, 4.88 ± 0.03; and ^{197m}Au; 7.86 ± 0.04. The data are presented and the methods of analysis are discussed. The results are compared to recent literature values. (3 figures, 2 tables) (auth)

27021 COMPUTER CODE FOR CALCULATING GAMMA-RAY ANGULAR CORRELATIONS FOR PURE OR MIXED MULTIPOLARITY TRANSITIONS CONNECTING STATES OF HIGH ANGULAR MOMENTA. Haustein, P. E. (Brookhaven National Lab., Upton, N. Y.). Nucl. Instrum. Methods; 99: No. 3, 433-8(1972).

A FORTRAN IV program is described for calculating theoretical gamma-ray angular correlations for pure or mixed-multipolarity transitions connecting states of high angular momenta ($\leq 80\ \hbar$). The program calculates the correlation coefficients, and anisotropy, and lists the angular distribution function, $W(\theta)$. Plots of $W(\theta)$ versus θ can also be obtained. (3 figures, 3 tables) (auth)

27022 ATOMIC BEAM MAGNETIC RESONANCE INVESTIGATIONS IN THE $^3F_2$ GROUND STATE OF ^{177}Hf, ^{179}Hf, AND ^{180}Hf. Buettgenbach, S.; Meisel, G. (Univ., Bonn). Z. Phys.; 250: No. 1, 57-67(1972).

The $5d^26s^2\ ^3F_2$ ground state of ^{177}Hf, ^{179}Hf and ^{180}Hf has been studied using the atomic beam magnetic resonance method. The atomic beam was produced by an universal evaporation technique. The results are ^{180}Hf $g_J(^3F_2) = 0.695812$ (10), ^{177}Hf $\Delta\nu(^3F_2;\ F = 11/2 \rightarrow F = 9/2) = 991.7917$ (10) MHz, $\Delta\nu(^3F_2;\ F = 9/2 \rightarrow F = 7/2) = 477.0081$ (10) MHz, $\Delta\nu(^3F_2;\ F = 7/2 \rightarrow F = 5/2) = 162.8890$ (10) MHz, ^{179}Hf $\Delta\nu(^3F_2;\ F = 13/2 \rightarrow F = 11/2) = 82.1320$ (10) MHz, and $\Delta\nu(^3F_2;\ F = 11/2 \rightarrow F = 9/2) = 392.8498$ (10) MHz. The magnetic dipole and electric quadrupole moments of the ^{177}Hf and ^{179}Hf nuclear ground states as calculated from these hyperfine structure measurements are the following: $\mu(177) = 0.75$ (8) μ_K, $Q(177) = 4.34$ (65) barns; $\mu(179) = -0.61$ (6) μ_K, $Q(179) = 4.90$ (75) barns. (auth)

27023 LEVELS IN ^{189}Ir STUDIED IN THE DECAY OF ^{189}Pt. Hedin, G.; Baecklin, A. (Swedish Research Councils' Lab., Nykoeping). Nucl. Phys.; A184: No. 1, 214-40(1972).

The decay ^{189}Pt → ^{189}Ir was studied with Ge(Li) and Si(Li) detectors in singles and coincidence; 157 transitions were found below 1.82 MeV, most of them not earlier reported. About 80% of the transitions were fitted into a level scheme containing 31 certain and 7 tentative levels. In addition to the well-known low-

lying $K = 3/2^+$ and $K = 1/2^+$ rotational bands, which have been assigned as the $3/2^+$ (402) and the $1/2^+$ (400) orbitals, respectively, evidence was found for the $1/2^-$ (541) and $3/2^-$ (532) orbitals at 540 and 828 keV, respectively. The possibility of classifying some of the positive-parity states between 0.7 and 1.0 MeV as associated with a smaller deformation than that of the ground state is discussed. (6 figures, 2 tables) (auth)

27024 ROTATION–PARTICLE COUPLING IN THE GROUND STATE BAND OF ^{161}Dy. Hjorth, S. A.; Johnson, A.; Ehrling, G. (Research Inst. for Physics, Stockholm). Nucl. Phys.; A184: No. 1, 113-37(1972).

The ^{158}Gd(α,3n)^{161}Dy reaction was used to populate the $5/2^+$ [642] ground-state band in ^{161}Dy up to the member with spin $33/2$. The rotational energies within this strongly perturbed band are successfully explained within the unified model with the pairing, Coriolis, and $\Delta N = 2$ interactions included if the theoretical Coriolis matrix elements are reduced. This model can at the same time account for the relative electromagnetic transition probabilities and the static magnetic moment of the $5/2$, $5/2^+$ [642] ground state only if the intraband M1 transition amplitudes with $|\Delta K| = 1$ are also reduced. The same conclusion may be drawn from an analogous analysis of the $7/2^+$ [633] band in ^{167}Er. These observations suggest that the longitudinal and the transverse spin polarization is different or that the mechanism which is responsible for the reduction of the Coriolis force is also effective in preventing intraband M1 transitions with $|\Delta K| = 1$. (7 figures, 6 tables, 46 references) (auth)

27025 INTERNAL CONVERSION OF THE 208 keV E1 TRANSITION IN ^{177}Hf. Holmberg, L.; Stefansson, V.; Gunnerhed, M. (Univ. of Stockholm). Phys. Scr.; 4: No. 1-2, 41-4(1971).

The internal conversion process of the 208 keV retarded E1 transition in ^{177}Hf is studied by measuring the electron-gamma and gamma-gamma directional correlations of the 208-113 keV cascade. The result for the ratio between directional correlation coefficients, $A_2(K)/A_2(\gamma) = -1.66 \pm 0.04$, is in agreement with the theoretical value for a pure E1 transition, -1.68. The result for the "nuclear current" penetration parameter, $\lambda_1 = -0.15 \pm 0.25$, agrees with that calculated from the penetration effect of the 321 keV transition in ^{177}Hf by use of the branching rules in the rotational model. (auth) (Sweden)

27026 ENERGY LEVELS IN ^{175}Yb FROM PRIMARY TRANSITIONS IN THE THERMAL NEUTRON CAPTURE REACTION. Alenius, G.; Arnell, S. E.; Schale, C.; Wallander, E. (Chalmers Univ. of Tech., Goteborg). Phys. Scr.; 4: No. 1-2, 35-9(1971).

The energies and intensities of high energy gamma radiation from thermal neutron capture in an enriched sample of ^{174}Yb have been determined by means of a Ge(Li) pair spectrometer. An internal reactor target has been used. A number of new primary gamma lines corresponding to transitions in ^{175}Yb between the capture state and energy levels up to 2.2 MeV with low K-values have been observed. The neutron separation energy of ^{175}Yb was found to be 5,822.6 ± 0.5 keV. (auth) (Sweden)

27027 SPIN OF THE 1518 keV LEVEL IN ^{174}Yb. Gidefeldt, L.; Eriksson, L.; Bargholtz, Chr.; Holmberg, L. (Univ. of Stockholm). Phys. Scr.; 4: No. 1-2, 33-4(1971).

The isomeric state at 1,518 keV in ^{174}Yb has been interpreted as a two-neutron state. The spin and parity have been suggested to be 6^+ or 7^-. The 992–273 keV gamma-gamma directional correlation is measured in this work. The result is only compatible with I = 6. The structure of the 1,518 keV state should then be $5/2^-$ (512) + $7/2^-$ (514). (auth) (Sweden)

27028 STRUCTURE OF DEFORMED ODD-PROTON NUCLEI IN THE RARE-EARTH REGION: A STUDY OF THE DECAY SCHEME ^{161}Er. Wood, John Lee. Worcester, Mass.; Clark Univ. (1971). 372p. University Microfilms Order No. 72-3346. Thesis.

The levels of ^{161}Ho populated in the decay of ^{161}Er were studied by gamma-singles and gamma-coincidence spectroscopy using Ge(Li) detectors. Over 180 gamma-rays in the energy range 75-1870 keV were assigned to the decay of ^{161}Er on the basis of half-life data. Limited data on multipolarities and log ft values were deduced. 146 of the gamma-rays were incorporated into a scheme for ^{161}Ho containing 38 levels. This accounted for over 96% of the decay intensity. Combining the results with independent studies of ^{161}Ho by reaction gamma-ray spectroscopy, the $1/2^+$ [411] rotational band was completely characterized up to spin $21/2$ and exhibited a smooth variation of inverse moment of inertia with I^2 for the $(I + 1/2)$ = even and $(I + 1/2)$ = odd band members. The $K^\pi = 3/2^-$ gamma-vibration built on the ground state, located at 592 keV, was observed to have decay branches to other than the ground-state — namely to the states I,K^π [Nn_zA]: $3/2,1/2^+$ [411], $3/2,3/2^+$ [411], $5/2,1/2^+$ [411] and $5/2,3/2^+$ [411]. This was interpreted as due to the presence of admixtures of single-particle states with $K^\pi = 3/2^-$, rather than as evidence for a microscopic structure of collective gamma-vibrations. The location of the single-quasiparticle states was compared with crude calculations based on a modified deformed harmonic oscillator potential with pairing and a deformed Woods-Saxon potential with pairing. The harmonic oscillator potential gave remarkably good agreement with the above results whereas the Woods-Saxon potential exhibited serious failures. Ancillary studies of the levels of ^{163}Ho and ^{161}Dy populated in the decay of ^{163}Er and ^{161}Ho respectively were made using gamma-singles spectroscopy with Ge(Li) detectors. Only preliminary results are presented. A result of note is the population of the ^{161}Dy excited state $5/2,3/2^-$ [512] at 790.7 keV in the decay of ^{161}Ho. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 26862, 26898, 26906, 26940, 26965, 26982, 26994, 26996, 27014, 27020, 27042, 27050, 27053, 27096, and 27108.

27029 (JINR–P6-6250) STUDY OF THE ^{194}Tl DECAY. Amov, B.; Vandlik, T.; Vandlik, Ya.; Vylov, Ts.; Zhelev, Zh.; Zaitseva, N. G.; Penev, I.; Tyrroff, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). Feb 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The decay of mass-separated ^{194}Tl was studied by using spectrometers with Ge(Li)- and Si(Li)-detectors and cooled field transistors. Gamma-ray spectra and those of conversion electrons are also studied. A number of new transitions were observed, and α_K for 26 γ-transitions was determined. New states are introduced into decay mode. (auth)

27030 (RLO–2227-T-7-9) FISSION FRAGMENT ANGULAR MOMENTUM IN CHARGED PARTICLE INDUCED FISSION. II. ^{95}Nb ISOMER RATIOS. Loveland, W.; Vieira, D. J.; Hill, D. W. (Oregon State Univ., Corvallis). [1969]. 20p. Dep. NTIS.

The ^{95}Nb isomer ratio was measured for the two fission reactions ^{209}Bi(α,f) at 35 MeV and ^{232}Th(p,f) at 10 MeV. The values of the ^{95}Nb isomer ratio ($\sigma_m/(\sigma + \sigma g)$) were 0.030 ± 0.003 and 0.040 ± 0.004, respectively. The average initial fragment angular momentum, I_{rms}, was deduced from the isomer ratio values by using the Vandenbosch–Huizenga formalism. The parameters used in the Vandenbosch–Huizenga calculation were determined in a separate study of the ^{95}Nb isomer ratio from the ^{96}Zr(p,2n)^{95}Nb reaction. The values deduced for I_{rms} were 12 ± 1$\hbar$ and 15 ± 1$\hbar$ for the fission of ^{232}Th and ^{209}Bi, respectively. The results are discussed in terms of current theories about the origin of the fragment angular momentum in fission. (1 figure, 2 tables) (auth)

27031 DECAY OF ^{207}Po AND ^{205}Po. Shilin, V. A.; Burmistrov, V. R. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1653-62(Aug 1971). (In Russian).

The γ radiation released during decay of ^{207}Po and ^{205}Po was studied with a single-crystal Ge(Li) spectrometer (anti-Compton and anti-coincidence). The subject isotopes were produced by a (α,3n) reaction on the enriched isotopes ^{206}Pb and ^{204}Pb, respectively. Seven new lines were detected in the ^{207}Po spectrum and four in the ^{205}Po spectrum. A series of γ transitions reported elsewhere were not confirmed. The schemes of levels and transitions for ^{205,207}Bi were quantitatively established. (tr-auth)

27032 DEUTERON DISINTEGRATION IN GOLD AND LEAD NUCLEI. Grantsev, V. I.; Dryapachenko, I. D.; Kornilov, A. V.; (and others) (Inst. of Nuclear Research, Kiev). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1747-9(Aug 1971). (In Russian).

Gold and a natural mixture of the isotopes of lead were used as targets in a study of (d,pn) reactions with 13.6 MeV deuterons. Differential cross section values with a possible ±40% error were obtained. Angular n-p correlations of the Au and Pb nuclear reactions are discussed, and a two-dimensional spectrum is schematically presented. (K.S.W.)

27033 ELASTIC ELECTRON SCATTERING FROM ^{208}Pb AT MODERATE MOMENTUM TRANSFERS AND MODEL-INDEPENDENT DESCRIPTION OF THE NUCLEAR CHARGE DISTRIBUTION. Friedrich, J. (Univ., Mainz); Lenz, F. Nucl. Phys.; A183: No. 3, 523-44(1972).

Cross sections for the elastic scattering of electrons have been measured at incident energies of 124 and 167 MeV. A fit to the experimental data with a Fermi-like charge distribution yields satisfactory agreement with the results of the recent Stanford measurements. By the model-independent analysis, it is shown that from the experiment reliable information about the nuclear charge distribution can be obtained for a certain middle region of the nu-

cleus. This information is described model-independently by two functions, the mean radius function and the moment function. By means of these functions the model dependence of the fitted Fermi-like distribution is discussed. The results of the analysis are compared with corresponding results derived from phenomenological distributions which are fitted to other measurements. (auth)

27034 NEW ^{204}Au ACTIVITY AND THE DECAY OF ^{202}Au. Pakkanen, A.; Komppa, T.; Helppi, H. (Univ. of Jyvaeskylae, Finland). Nucl. Phys.; A184: No. 1, 157-65(1972).

A new 40 ± 3 s activity, assigned to ^{204}Au, was found by bombarding natural mercury targets with 14- to 15-MeV neutrons. The decay of this nucleus and ^{202}Au ($T_{\frac{1}{2}}$ = 29 ± 3s) was studied by employing Ge(Li), NaI(Tl), and plastic detectors and coincidence systems. No trace of the previously reported 4.0 ± 1.0 s activity of ^{204}Au was observed. (4 figures, 1 table) (auth)

27035 NOTE ON THE LEVEL STRUCTURE OF ^{199}Au. Seetharamanath, M. N.; Sastry, B. R.; Parthasaradhi, K. (Andhra Univ., Waltair, India). Indian J. Phys.; 44: No. 8, 469-71(Aug 1970).

The core-excitation model was used to calculate the energy levels and the transition rates of ^{199}Au. The energies of the low-lying levels of the other odd-A gold isotopes were also calculated and compared with experiment. It is concluded that the core-excitation model gives a reasonable agreement with experiment in spite of its simplicity. (2 tables) (R.W.R.)

27036 ANGULAR-CORRELATION STUDIES IN THE DECAY OF ^{198}Au. Rao, K. Venkata Ramana; Lakshminarayana, V. (Andhra Univ., Waltair, India). Nuovo Cim.; 8A: No. 2, 298-304 (21 Mar 1972).

The angular correlation of the $\gamma-\gamma$ cascade 676–412 keV in the decay of ^{198}Au was studied with the aid of a high-efficiency sum-peak coincidence arrangement. The resultant correlation pattern is $W(\theta) = 1 - (0.272 \pm 0.01)\ P_2 \cos\theta + (0.143 \pm 0.006)\ P_4 \cos\theta$. Under the assumption of a $2^+-2^+-0^+$ spin sequence connecting the cascade, the present correlation coefficients are used to obtain the mixing ratio of the 676-keV transition to be 0.85 ± 0.06. The results indicate monopole contribution and an admixture of particle and collective excitations in the 676-keV transition in ^{198}Hg. Vibrationlike wave functions furnished by Covello and Sartoris, and Ialongo and Alaga, for the 2^+ states are used, and the mixing ratios are estimated to be 5.03 and 0.143, respectively. It is concluded that the vibrationlike wave functions based on microscopic models are not adequate for describing the second 2^+ state in ^{198}Hg. (2 figures, 1 table) (auth)

27037 HALF-LIFE AND EMISSION OF ^{202}Au. Bunus, F. T. (Inst. of Atomic Physics, Bucharest). J. Inorg. Nucl. Chem.; 34: No. 3, 1087-8(Mar 1972).

Half-life determinations were made based on β-counting the material formed by the ^{205}Tl(n,α)^{202}Au reaction using 14.5 MeV neutrons. Comparisons were made with determinations based on γ-spectrometry of a Hg target irradiated with 14.5 MeV neutrons ^{202}Hg(n,p)^{202}Au. When a Tl target is irradiated no other short lived component interfering with ^{202}Au appears. Using β-counting and with all corrections a half-life of 27 ± 2 sec was found. The only γ-quanta ascribed to ^{202}Au was that of 0.43 MeV. (UK)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 25640, 26906, 27030, 27087, and 27096.

27038 (COO–1716-13) THERMODYNAMIC STUDIES ON HEAVY ELEMENTS AND STUDIES IN NUCLEAR CHEMISTRY. Annual Report, February 1971–January 1972. Cobble, J. W. (ed.) (Purdue Univ., Lafayette, Ind. Dept. of Chemistry). 1 Jan 1972. Contract AT(11-1)-1716. 33p. Dep. NTIS.

ACTINIDES—oxidation, reduction potentials of
EUROPIUM—thermodynamic properties of, in aqueous solutions
GOLD-197—carbon-12 fission at 70 to 115 MeV, excitation functions for ternary, (E) p. 11–13
PLUTONIUM-239—alpha fission at 44.5 MeV, yields for ternary, (E) p. 2–7
URANIUM-238—carbon-12 fission at 108 MeV, yields for ternary, (E) p. 7–11
URANYL COMPOUNDS—thermodynamic properties of (M.C.G.

27039 (COO–3058-1) LINEAR ACCELERATOR PROJECT. Annual Technical Report, October 1, 1970–September 30, 1971. Gaerttner, Erwin R. (Rensselaer Polytechnic Inst., Troy, N. Y. Contract AT(30-1)-328. 159p. Dep. NTIS.

IRON—neutron total cross section for, area analysis of thick-sample transmission measurement of
IRON-54—neutron capture at 6 to 250 keV, γ spectra from, (E)
LINEAR ACCELERATORS—experimental facilities at RPI, resolution studies on proton-recoil detectors at 250-meter station
LITHIUM-7—neutron total cross section at 1 to 25 MeV, (E)
NEUTRON SOURCES—radiation target for electron linac, performance of
NUCLEI—neutron reactions with, optical-model fit to p-wave strength functions for, (T)
PLUTONIUM-240—neutron capture at 4 to 30 keV, cross section for, (E)
RADIATION DETECTORS, SCINTILLATOR (LIQUID)—resolution of proton-recoil, at RPI linac
RADIATION TARGETS—performance of tantalum-lead, as electron linac neutron source
REACTOR MODERATORS—neutron leakage spectra from pulsed, leakage probability approach to
SODIUM—neutron spectra and emission times in steel-contained assembly of, fast (J.W.R.)

27040 (JINR–P3-6239) INTERMEDIATE STRUCTURE IN THE CROSS SECTION OF ^{235}U AND ^{239}Pu FISSION BY EPITHERMAL NEUTRONS. Mateeva, A.; Yaneva, N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1971. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

Averaged cross sections of ^{235}U and ^{239}Pu fission by neutrons with the energy up to 2000 eV are analyzed in terms of the Strutinsky hypothesis about the second "well" in the dependence of the nucleus excitation energy on its deformation. The parameters of the gross-structure are determined. (auth)

27041 (JINR–P15-6145) EXCITATION ENERGY MEASUREMENT FOR SPONTANEOUSLY FISSIONING ISOMER ^{239}Pu. Gangrskii, Yu. P.; Markov, B. N.; Kharisov, I. F.; Tsipenyuk, Yu. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

The excitation function for the reaction ^{240}Pu(γ,n), leading to the production of the spontaneously fissioning isomer ^{239}Pu ($T^{\pi}_{\frac{1}{2}}$ = 8.5 μs), is measured. The measured excitation function is analyzed in the framework of two-hump fission barrier at different assumptions on the reaction mechanism. It is shown that the reaction threshold value, and therefore the excitation energy of the fissioning isomer, depends essentially on the choice of the reaction mechanism. (auth)

27042 (RLO–2227-T-7-11) FISSION-FRAGMENT ANGULAR MOMENTUM IN CHARGED-PARTICLE INDUCED FISSION. I. ^{134}Cs AND ^{115}Cd ISOMER RATIOS. Loveland, W. D.; Shum, Y. S. (Oregon State Univ., Corvallis). [1971]. 28p. Dep. NTIS.

The ^{134}Cs and ^{115}Cd isomer ratios were measured for the following cases of charged particle-induced fission: ^{238}U(α,f) at 35 MeV, ^{232}Th(d,f) at 20 MeV, ^{226}Ra(d,f) at 19 MeV, and ^{209}Bi(α,f) at 35 MeV. The values of the ^{134}Cs isomer ratio were 0.52 ± 0.02, 0.64 ± 0.01, and 0.20 ± 0.05 for the fission of ^{238}U, ^{232}Th, and ^{226}Ra, respectively. The ^{115}Cd isomer ratios were 0.09 ± 0.006, 0.059 ± 0.007, 0.90 ± 0.12, and 0.9 ± 0.2 for the fission of ^{238}U, ^{232}Th, ^{226}Ra, and ^{209}Bi, respectively. The low values of the ^{115}Cd isomer ratios for the fission of ^{238}U and ^{232}Th are attributed to decay scheme effects. The average initial fragment angular momentum was deduced from the isomer ratio values by using the Vandenbosch–Huizenga formalism. The values obtained were 11 ± 1 h, 13 ± 1 h, and 7 ± 2 h for the ^{134}Cs fragment in the fission of ^{238}U, ^{232}Th, and ^{226}Ra, respectively. Values of >15 ± 4 h and >13 ± 4 h for the ^{115}Cd fragment in the fission of ^{226}Ra and ^{209}Bi were obtained. These results are discussed in terms of current theories about the origin of the fragment angular momentum in fission. (2 figures, 2 tables) (auth)

27043 (UCRL-Trans-10582) ROTATION BANDS BUILT ON OCTUPOLE VIBRATIONS. Dzyublik, A. Ya. Translated for Univ. of California, Lawrence Livermore Lab., Livermore, from Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 6, 894-9(1971). 10p. Dep. NTIS.

To describe properties of odd parity rotational bands observed in some even-even nuclei the asymmetric rotator model is used. The rotational energies and ratios of the reduced E1-transition probabilities are calculated. (auth)

27044 PRODUCTION OF IODINE AND BROMINE ISOTOPES FROM URANIUM AT HIGH PROTON ENERGIES. PART II. MONTE-CARLO EVAPORATION CALCULATIONS. Stark, G.; Brandt, R. (Philipps-Univ., Marburg, Ger.). Radiochim. Acta; 16: No. 3-4, 155-9(Dec 1971).

The standard Monte Carlo evaporation program is used to calculate the shape of the deep spallation part of the isotopic yield curve for bromine and iodine produced by 18 GeV protons in uranium. The agreement between experimental and calculated results is satisfactory. However, it is impossible to calculate the proper

mean kinetic energy $\overline{E_{kin}}$ of bromine and iodine residual nuclei without obtaining unrealistically large values for the forward-to-backward F/B ratio. The experimental value of $\overline{E_{kin}}$ can be understood, when it is assumed, that in each cascade one particle like ^{32}S is evaporated. (auth)

27045 PRODUCTION OF IODINE AND BROMINE ISOTOPES FROM URANIUM AT HIGH PROTON ENERGIES. PART I. EXPERIMENTAL. Brandt, Reinhard (CERN, Geneva). Radiochim. Acta; 16: No. 3-4, 148-55(Dec 1971).

The ranges of radioactive iodine and bromine isotopes produced at 0.55 GeV and 18 GeV in uranium are determined. At 0.55 GeV the ranges of all isotopes are mass-independent, indicating that at this energy iodine and bromine isotopes are fission products. At 18 GeV, the ranges of neutron-deficient products decrease by a factor of two. A step-like range-vs.-isotopic mass is observed for iodine and also to some extent for bromine. The results of the range and yield measurements are qualitatively discussed in this paper. It is suggested to decompose the observed isotopic yield curves into a fission and deep spallation component. Some more quantitative calculations are presented in the consecutive paper. (auth)

27046 ELECTRON CAPTURE OF ^{235}Pu. Keller, K. A.; Muenzel, H. (Nuclear Research Centre, Karlsruhe, Ger.). Radiochim. Acta; 16: No. 3-4, 138-40(Dec 1971).

The half-life of ^{235}Pu and the energy and intensity of four new γ-lines were determined. Using the proposed decay scheme, the mean excitation energy of the electron capture was obtained and its deviation from the predicted value is discussed. The half-life calculated with the aid of the mean excitation energy agrees very well with the experimental values. (auth)

27047 FISSION CROSS SECTION OF ^{249}Cf FOR THERMAL AND FAST NEUTRONS. Fursov, B. I.; Androsenko, Kh. D.; Ivanov, V. I.; (and others). At. Energ. (USSR); 32: No. 2, 178-9 (Feb 1972). (In Russian).

Targets of ^{249}Cf were prepared by electrodeposition of about 3 μg on thin Pt foils, which were accordingly irradiated either in the thermal column of a reactor or by an electrostatic generator of fast neutrons for fission cross section measurements. The values obtained for ^{249}Cf were $\sigma_f = 1,619 \pm 13$ barns for thermal neutrons; σ_f = from 1.36 to 2.00 barns for neutrons ranging in energies from 0.5 to 5.02 MeV (with an apparent minimum of 1.36 barns at 0.850 MeV). (K.S.W.)

27048 CAPTURE CROSS SECTION OF ^{231}Pa FOR SLOW NEUTRONS. Aleksandrov, B. M.; Bak, M. A.; Krivokhatskii, A. S.; Shlyamin, E. A. At. Energ. (USSR); 32: No. 2, 178(Feb 1972). (In Russian).

The capture cross section of ^{231}Pa was measured using the reaction: $^{231}Pa(n,\gamma)^{232}Pa \xrightarrow{\beta} {}^{232}U$. The target was prepared by electrodeposition of microgram quantities of ^{231}Pa on a Ti support, and then exposed to a slow neutron flux in a nuclear reactor. The capture cross section of ^{231}Pa was thus found to be 260 ± 13 barns. (K.S.W.)

27049 RELATIVE PROBABILITY OF ^{242}Am β-DECAY. Gabeskiriya, V. Ya. At. Energ. (USSR); 32: No. 2, 177(Feb 1972). (In Russian).

A sample of ^{241}Am was exposed to a neutron flux of such integral magnitude that burn-up of accumulating ^{242}Pu, ^{242}Cm, is achieved. The relative probability of β-decay and electron capture of ^{242}Am is then equivalent to the ratio of the numbers of atoms $^{238}Pu/^{242}Pu$. The value 0.827 agrees satisfactorily with previously published data. (K.S.W.)

27050 POTENTIAL ENERGY OF HEAVY NUCLEI AT ASYMMETRICAL FISSION. Adeev, G. D.; Gamalya, I. A.; Cherdantsev, P. A. (Tomsk Polytechnic Inst., USSR). Yadern. Fiz.; 14: No. 6, 1144-50(Dec 1971). (In Russian).

A method is proposed to obtain a simple one-nucleon potential for any axially symmetric nuclear shape occurring in fission. The results of a calculation of the potential energy of fissile nuclei as a function of three collective coordinates are given. The minimal fission barriers correspond to asymmetry parameters 0.55, 0.63, 0.75, and 0.78, respectively, for ^{226}Ra, ^{232}Th, ^{252}Cf, and ^{254}Cf: a linear dependence of the asymmetry parameter on the mass number of the fissile nuclei is seen. The mass of the heavy fragment remains constant. (4 figures) (auth)

27051 SPONTANEOUS FISSION PREVIOUSLY OBSERVED IN A MERCURY SOURCE. Marinov, A. (Rutherford High Energy Lab., Chilton, Eng.); Friedman, A. N.; Newton, G. W. A.; (and others). Nature (London); 234: No. 5326, 212-15(26 Nov 1971).

Reference is made to Nature 229: 464(1971) where the authors presented evidence for the possible existence of a superheavy element with Z = 112, based principally on the observation of spontaneous fission in a Hg source separated from a W target irradiated with 24 GeV protons. The argument that the observed activity might be due to a super-heavy element was based on the prediction that Element 112 would be the chemical homologue of Hg. Attempts were subsequently made to identify the source of the observed fission activity by trying to measure nuclear properties that depend in some way on Z or A of the fissioning nucleus, and the present communication is intended to be a progress report on this work. Consideration was given as to whether ^{252}Cf might be the spontaneous fissioning source. It is pointed out that the possibility of non-binding fission cannot be ruled out for superheavy elements, so that any conclusions based on the assumption of binary fission must be regarded with caution. The experimental work is described in detail and the results discussed. Both the α/f ratios and subsequent chemical separations indicated that at the time of measurements 70% of the fission activity was due to ^{252}Cf. After subtraction of the ^{252}Cf component the residual fission kinetic energy spectra differed considerably from known actinides. A possibility is that the distribution of kinetic energies could represent the spectrum of fragment energies produced in an unusual mode of fission such as predicted for superheavy elements. (UK)

27052 FLUORESCENCE YIELD FOR THE L_2 SUBSHELL IN CURIUM. Solov'ev, S. M.; Tyvin, L. I.; Eismont, V. P. Zh. Eksp. Teor. Fiz.; 62: No. 1, 31-4(Jan 1972). (In Russian).

The spectrum of the characteristic L radiation produced in α decay of ^{252}Cf is measured with a Si(Li) high-resolution spectrometer. The contributions of the L_2 and L_3 subshells in the spectrum are separated and on this basis the fluorescence yield for the L_2 subshell of the Z = 96 atom is determined. The result is compared with predictions of the semi-empirical Listenharten theory. (auth)

27053 VELOCITY MEASUREMENTS OF RECOIL NUCLEI FROM α-DECAY AND THE DETERMINATION OF THEIR MASS. Batty, C. J.; Kilvington, A. I.; Marinov, A. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Instrum. Methods; 99: No. 2, 179-82(1972).

The velocity of nuclei recoiling from α decay was measured by using a time-of-flight method. The recoils were detected by NE102A plastic scintillator. The use of this technique to measure the mass of α-emitting isotopes is described. (2 figures) (auth)

27054 ABSOLUTE α MEASUREMENTS FOR ^{235}U AND ^{239}Pu AT NEUTRON ENERGIES FROM 10 keV TO 1 MeV. Kononov, V. N.; Poletaev, E. D.; Prokopets, Yu. S.; Metlev, A. A.; Staviskii, Yu. Ya. At. Energ. (USSR); 32: No. 1, 85-7(Jan 1972). (In Russian).

Values of α for ^{235}U and ^{239}Pu for fast neutrons were determined in the energy range from 10 keV to 1 MeV. The work was accomplished with a time-of-flight spectrometer, a pulsed Van de Graaff electrostatic accelerator, and a large (400 liters) liquid scintillation detector with a solution of $Cd(NO_3)_2$ at the center. The results are submitted in graphical form with those of other workers included for comparison. (K.S.W.)

27055 L_1 SUBSHELL FLUORESCENCE AND COSTER–KRONIG YIELDS FOR Z = 96. McGeorge, J. C.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Z. Phys.; 250: No. 4, 293-9 (1972).

High resolution Si(Li)–Si(Li) and Si(Li)–Ge(Li) detector arrangements have been used to study L x-ray spectra in coincidence with L-shell internal conversion electrons, gamma rays, and K x-rays emitted in ^{249}Cf decay. The L_1 subshell fluorescence and Coster–Kronig yields determined for Z = 96 from these spectra are $\omega_1 = 0.25 \pm 0.06$, $f_{12} \leq 0.10$, and $f_{13} = 0.69 \pm 0.08$. The presence of the L_1–L_3 radiative transition is also further confirmed in this work. (auth)

27056 14 MeV NEUTRON-INDUCED FISSION AND 25 MeV PHOTO-FISSION OF ^{232}Th and ^{238}U. Gevaert, Lieven Hendrik Theofiel. Toronto; Univ. of Toronto (1968). National Library of Canada, Ottawa.

Thesis.

^{232}Th and ^{238}U were irradiated with 14.7-MeV neutrons and 25-MeV bremsstrahlung radiation, and symmetrical-fission product yields were quantitatively determined using radiochemical separation techniques. The fission yields that were determined are in the mass region from 99 to 125. The yields of ten mass chains, determined in the neutron-induced fission portion of this study by means of the quantitative mass yield assay of the nuclides were: ^{99}Mo, ^{103}Ru, ^{105}Ru, ^{109}Pd, ^{112}Pd, ^{111}Ag, ^{113}Ag, ^{115}Cd, ^{121}Sn, ^{125}Sn. The yields of nine mass chains were determined in the photofission study by means of the quantitative mass yield assay of the same nuclides except ^{113}Ag. The results of the neutron-induced fission and the photofission of ^{232}Th are the first consistent set of radiochemical data obtained in the symmmetric region of the mass yield

curve. The neutron-induced fission results are in agreement with the results that were obtained at the same time as this work in another laboratory. The study has shown that there is a distinct third peak in the symmetric region of the mass yield curves of ^{232}Th fissioned both with neutrons and photons. No such maximum was observed in the symmetric region of the mass yield curves of ^{238}U. The results of ^{232}Th fission are consistent with the two-fission-mode hypothesis, but there is no such comparable evidence in the results of ^{238}U fission. (Diss. Abstr. Int., B)

27057 THRESHOLD PHOTOFISSION WITH ELECTRON ACCELERATORS: WHY, HOW, AND APPLICATIONS. Gozani, Tsahi (Univ. of Tel-Aviv, Israel). Atomkernenergie; 19: No. 1, 63-9(Feb 1972).

The motivation and purpose for doing low energy photofission studies using the Bremsstrahlung beams from low energy electron accelerators are reviewed. The present situation in differential and integral measurements of various photofission parameters and their pertinence to the fission process is briefly given. The application of photofission to the nondestructive assay of nuclear materials is described. (auth)

27058 FISSIONING ISOMERS OF AMERICIUM, CURIUM, AND BERKELIUM ISOTOPES. Wolf, K. L.; Unik, P. (Argonne National Lab., Ill.). Phys. Lett.; 38B: No. 6, 405-7(20 Mar 1972).

New spontaneously fissioning isomers $^{245}Am^{m}$(640 ± 60 ns) $^{246}Am^{m}$(73 ± 10 μs), $^{242}Bk^{m1}$ (9.5 ± 2.0 ns), $^{242}Bk^{m2}$ (600 ± 100 ns) and $^{244}Bk^{m}$ (820 ± 60 ns) have been produced and identified by bombardment of ^{242}Pu, ^{244}Pu, ^{241}Am and ^{243}Am targets with 25–46 MeV α particles. Data also have been obtained for several previously reported fissioning isomers such as $^{243}Cm^{m}$ (42 ± 6 ns) and $^{245}Cm^{m}$ (13.8 ± 1.2 ns). (auth)

Nuclear Theory

Refer also to abstracts 26412, 26559, 26777, 26789, 26880, 26957, and 27043.

27059 (DP–1278) FLANGE II (VERSION 71-1): A CODE TO PROCESS THERMAL NEUTRON DATA FROM AN ENDF/B TAPE. Honeck, Henry C.; Finch, Donald R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Oct 1971. Contract AT(07-2)-1. 116p. (ENDF–152). Dep. NTIS.

The FLANGE II (Version 71-1) computer code processes data for smooth cross sections, resonance parameters, angular distributions, and thermal scattering law from an ENDF/B-II or ENDF/B-III data tape for use in thermal spectrum calculations. Options are available in the code to produce pointwise or group-averaged cross sections for up to 200 energy points or groups, and Legendre angular distributions up to P_5 order. Resonance contributions in the thermal region are computed as infinitely dilute, Doppler broadened values. The theory, methods, application, and utilization of FLANGE II in creating thermal cross sections from ENDF/B-II and ENDF/B-III library data are described. (auth)

27060 (ITF–71-74-E) CLUSTER STRUCTURE OF THE THREE-PARTICLE BOUND STATES. Filippov, G. F.; Ovcharenko, V. I.; Simenog, I. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 46p. Dep. NTIS (U. S. Sales Only).

Coefficients are found to determine the probability that in a given bound state of three particles interacting by means of the pair short-range forces, two particles make up a bound system (the cluster) in the ground and excited states. The wave functions of two- and three-particle systems are defined, by using the method of expanding in inverse powers of the interaction parameter. Dependence of the above probabilities on the interaction parameter $g = mr_0^2/\hbar^2 V_0$(V_0 is the depth of two-particle potential; r_0 its radius) is investigated for a number of two- and three-particle states. In part, the probability that the two-particle ground state is present in the ground and first excited states of three-particle system, makes up 0.985 and 0.5 for large g. Remaining almost constant in a wide range of g, this probability decreases with decreasing g for the three-particle ground state, but increases for an excited one. (auth)

27061 (JAERI–1206) NEUTRON ABSORPTION CROSS SECTION OF FISSION PRODUCT. (Report of FP Working Group No. 2). Iijima, Shungo; Kobayashi, Takatoshi; Sakata, Hajime (Japan Atomic Energy Research Inst., Tokyo). 5 Jun 1971. 33p. (In Japanese). Dep. NTIS (U. S. Sales Only).

The results of compilation and evaluation of thermal neutron absorption cross sections and resonance integrals of approximately 190 fission product nuclides ranging from Z = 32 to 68 are described. The calculated resonance integrals were compared with measured ones to determine the preferred values of resonance integrals. For the thermal neutron cross section values (2,200 m/sec) and their energy dependence were obtained. In addition, the multi-group cross section set was constructed for each of the fission products, with the group structure of MUFT type (54 group) in the fast energy region and THERMOS type (30 group) in the thermal region. These cross sections are stored as library data for the programs of FP CHAIN and FPPARA, which calculate the buildup of fission products on burn-up process and produce a multi-group cross section set for pseudofission products, respectively. The work was performed as the activity of the FP working group in the Reactor Constant Subcommittee, Japanese Nuclear Data Committee. (auth)

27062 (JINR–P4-6226) USE OF STURM–LIOUVILLE FUNCTIONS IN THE CALCULATIONS OF STRIPPING FORM FACTORS. Bunakov, V. E.; Gareev, F. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

The use of Sturm–Liouville functions is suggested for the calculation of the transferred nucleon form factor. In the framework of the configuration mixing it allows one to avoid the specific difficulties of the continuum diagonalization. A simple equation is derived for the form factors involving the usual well-depth prescription procedure as a zero approximation. (auth)

27063 (OULNS–71-8) CENTRIFUGAL STRETCHING EFFECT TO INTRA-BAND E2-TRANSITION RATES. Takemasa, Tadashi; Sano, Mitsuo (Osaka Univ. (Japan). Lab. of Nuclear Studies). [nd]. 7p. NTIS (U. S. Sales Only).

The angular momentum projection method is applied to the calculation of the intra-band (E2)-transition rates of even nuclei in the rare-earth region. It is shown that the centrifugal stretching model can reproduce the experimental results for the transitions in the higher spin states of the ground state rotational band with satisfying accuracy. (auth)

27064 EXPERIMENTS WITH RESONANCE SCATTERING OF NEUTRON CAPTURE γ RAYS. Davydov, A. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1530-41(Aug 1971). (In Russian).

The possibilities of using resonance scattering of 9 to 10 MeV neutron capture γ rays for investigating three-dimensional parity nonconservation in nuclear interactions, and also for studying the fine structure of the low-energy portion of giant resonances of photonuclear reactions were studied. (tr-auth)

27065 NUCLEON–NUCLEON INTERACTION AND OPTIMAL RELATIVITY. Fortes, M.; Jackson, A. D. (State Univ. of New York, Stony Brook. Neils Bohr Inst., Copenhagen). Phys. Lett.; 38B: No. 5, 277-80(6 Mar 1972).

The iterations of the Blankenbecler–Sugar equation are discussed, and phase shifts are calculated for superpositions of one-boson-exchange interactions. A comparison with results obtained with the Bethe–Salpeter equation shows that an essentially quantitative agreement is achieved. The relevance of these calculations is discussed in relation to current techniques employed in the derivation of two-pion-exchange contributions to the NN force. (auth)

27066 CONNECTION BETWEEN THE JASTROW METHOD AND BRUECKNER THEORY. Schaefer, K.; Schuette, G. (Univ., Heidelberg). Nucl. Phys.; A183: No. 1, 1-20(1972).

The usual Jastrow ansatz and the Iwamoto-Yamada cluster expansion are applied to the case of nuclear matter. The truncated energy functional including only two-body cluster terms and the resulting Euler equation are studied analytically. The Jastrow ansatz is then generalized, involving state-dependent correlation functions. The variation of the resulting energy functional under the "Pauli" subsidiary condition leads to the Bethe-Goldstone equation. From a similar variational principle the reference spectrum equation is obtained and compared with the state-averaged Jastrow procedure. (auth)

27067 SINGLE-PARTICLE ENERGY LEVELS IN A TWO-CENTRE SHELL MODEL. Johansson, T. A. (Lund Inst. of Tech., Sweden). Nucl. Phys.; A183: No. 1, 33-50(1972).

A two-center shell model, which behaves correctly at the two limits of one or two fragments, is formulated. The parameters of the model are adjusted so that equilibrium level orders are approximately reproduced. A classical Thomas–Fermi prescription is used for the volume conservation condition. Asymptotic basis states are employed and found adequate also for very constricted shapes. (auth)

27068 IMPORTANCE OF INDIRECT TRANSITIONS ON (p,t) REACTIONS ON DEFORMED NUCLEI. Ascuitto, R. J. (Yale Univ., New Haven); Glendenning, Norman K.; Soerensen, B. Nucl. Phys.; A183: No. 1, 60-80(1972).

The (p,t) reaction on deformed nuclei has been computed with the inclusion of indirect transitions that go through intermediate rotational states. The indirect transitions are almost as large as the direct for the 2^+ state and their inclusion is essential to bring about agreement with the shape and magnitude of the differential cross section. For the 4^+ state some of the indirect transitions are even stronger than the direct one. The sensitivity of the reaction to β_4 and β_6 terms in the shape has been investigated and found to be weak. (auth)

27069 EFFECTIVE CHARGE-DEPENDENT TWO-NUCLEON POTENTIAL. Yalcin, C. (Middle East Technical Univ., Ankara). Nucl. Phys.; A183: No. 1, 203-9(1972).

An effective charge-dependent two-nucleon potential with a Yukawa radial dependence is obtained by a least-squares fit with the charge-dependent potential arising from the ρ-meson electromagnetic mass difference. The observed discrepancy between the neutron-proton and proton-proton scattering lengths and effective ranges in the singlet S-state is examined in terms of this potential. The finite size of nucleons, magnetic interactions, the electromagnetic mass difference of pions, $\Delta\pi = \pi^+ - \pi^0$, and the isospin mixing of various mesons contribute to the observed difference in scattering lengths by at most 50%. The Coulomb and vacuum polarization potential corrected effective range for the proton-proton interaction shows also a small discrepancy with the neutron-proton effective range. The remaining part of these differences is attributed, in both cases, to the effective charge-dependent potential. In order to obtain agreement between neutron-proton and proton-proton scattering lengths and effective ranges we find $\Delta\rho = \rho^+ - \rho^0 = -2.8$ to -6.1 MeV. (auth)

27070 VECTOR BRACKET AND TRANSFORMED WAVE FUNCTION OF A FEW-BODY STATE. Wong, C. W.; Clement, D. M. (Univ. of California, Los Angeles). Nucl. Phys.; A183: No. 1, 210-24(1972).

Explicit expressions and symmetry properties are obtained for the vector bracket $\langle r_a l r_b L, \lambda | r_1 l_1 l_2, \lambda \rangle$ and for the corresponding transformed wave function of a two-body state. The equivalence between these results and certain expressions appearing in the angular-momentum decomposition of few-body problems is discussed. The rather fundamental role of these brackets and wave functions in few-body problems is pointed out. Further examples are given of their usefulness. In the Brueckner–Hartree-Fock problem they permit the dynamical equations in coordinate or momentum space to be written in forms suitable for numerical calculation. They also make possible the use of arbitrary single-particle wave functions in nuclear-structure calculations, as illustrated in a numerical study of the single-particle spin-orbit splitting in ^{16}O. (auth)

27071 INFLUENCE OF NUCLEAR STRUCTURE ON THE COEFFICIENTS OF INTERNAL CONVERSION AND COEFFICIENTS OF ANGULAR CORRELATION OF CONVERSION ELECTRONS DURING HIGH-ENERGY γ-CONVERSIONS. Listengarten, M. A.; Band, I. M.; Trzhaskovskaya, M. B. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1750-7(Aug 1971). (In Russian).

Coefficients of internal conversion were calculated for Z = 62, 92, and 102 at energies up to k ~ 50, using a "penetrationless" model and a "surface currents" model. Values of relative nuclear contributions to the multipole order are tabulated for each of the three atomic numbers. Parameters of the angular coefficients of conversion electrons at large energies are evaluated, and the effect of the structure of the nucleus is discussed. (K.S.W.)

27072 HERMITIAN CHARACTER OF THE SPIN-ORBITAL OPERATOR. Nemirovskii, P. E.; Chepurnov, V. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1758-9(Aug 1971). (In Russian).

The spin-orbit interaction plays an essential role in nuclear single-particle states. A relation between the spin, nucleon impulse, the potential, and a constant characteristic of a given shell is developed. It is shown that for a given nuclear potential the operator is Hermitian. (K.S.W.)

27073 OPTICAL POTENTIAL OF PARTICLES FOR DEFORMED NUCLEI. Kalechits, V. E.; Martynov, A. A.; Kadmenskii, S. G.; Furman, V. I. (Voronezh State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 8, 1760-3(Aug 1971). (In Russian).

The theoretical optical potential of composite particles for deformed nuclei is discussed. The effective parameters $\tilde{\beta}_2$, $\tilde{\beta}_4$ used in describing the deformed condition may be distinguished from the corresponding "bare" single-nucleon β_2, β_4. Accordingly the interpretation and comparison of parameters $\tilde{\beta}_2$, $\tilde{\beta}_4$, derived from experiments on elastic and inelastic scattering of composite particles by deformed nuclei and on the α-decay of deformed nuclei, with parameters β_2, β_4, obtained from calculations of equilibrium deformations, quadrupole moments, or from single-nucleon levels of deformed nuclei, should be conducted with caution. (K.S.W.)

27074 SEMICLASSICAL TREATMENT OF THE DYNAMIC ELLIPSOIDAL SHAPES IN NUCLEI. Pal, M. K. (International Centre for Theoretical Physics, Trieste, Italy). Nucl. Phys.; A183: A183: No. 3, 545-81(1972).

In the dynamics of collective vibration and rotation, nuclei in the deformed and transitional regions pass through ellipsoidal shapes of continuously varying deformation. As a first step towards working out these collective dynamics, exact classical expressions have been obtained for the surface, curvature and Coulomb energies of a nuclear droplet having an ellipsoidal shape. The kinetic energy corresponding to surface vibration and rotation has also been calculated using the classical picture of the irrotational motion of an incompressible fluid confined by an ellipsoidal boundary. The shell and pairing corrections to the nuclear energy are obtained, following a slightly modified version of Strutinsky's prescription. The shell-model potential used for this purpose has a harmonic-oscillator shape with equipotential surfaces having the same eccentricities as the ellipsoidal nuclear droplet. The collective Hamiltonian has then been taken to be the sum of the kinetic energy, and the surface, curvature and Coulomb energies together with the shell and pairing corrections. This Hamiltonian has then been quantized, as done by Bohr in his pioneering work on the collective model. A simple numerical method for solving the resultant Schroedinger equation has been worked out. (auth)

27075 INTEGRAL EQUATIONS FOR FOUR IDENTICAL PARTICLES. Kharchenko, V. F.; Kuzmichev, V. E. (Inst. for Theoretical Physics, Kiev). Nucl. Phys.; A183: No. 3, 606-24 (1972).

Based on the Faddeev–Yacubovsky approach, we obtain a set of integral equations for four particles in the simplest case when all the particles are identical and spinless (bosons). This set consists of two equations. The simplification of the obtained equations with use of separable two-body potentials is considered. The subsequent separable representation of the scattering amplitudes for subsystems reduces the equations to single-variable ones. (auth)

27076 FEATURES OF CORE POLARIZATION KNOCK-OUT EXCHANGE CONTRIBUTIONS TO INELASTIC NUCLEON SCATTERING. Geramb, H. V. (Univ., Muenster, Ger. Kernforschungsanlage, Juelich, Ger.). Nucl. Phys.; A183: No. 3, 582-92 (1972).

The collective virtual core excitation model is employed in the description of core polarization exchange contributions and the antisymmetrized microscopic DWBA theory of inelastic nucleon scattering. These numerical investigations extend the widely used direct core polarization corrections to include exchange terms arising from antisymmetrization of projectile and target nucleons. Several results are discussed in terms of angular momentum transfer and interaction multipolarity for scattering to low-lying states in ^{89}Y. (auth)

27077 INTERACTION OF HELIONS AND TRITONS WITH NUCLEI. Scherk, L. R.; Falk, W. R. (Univ. of Manitoba, Winnipeg). Nucl. Phys.; A183: No. 2, 240-56(1972).

The optical interaction of helions and tritons with nuclei is investigated by employing strongly absorptive potential which describes the underlying one-body structure of the forward elastic scattering cross section. The description is shown to be consistent with total reaction cross sections and transfer reaction cross sections. Conventional descriptions with optical potentials fitted to all aspects of the elastic scattering cross sections attempt to find one-body explanations for many-body effects. It is shown that this forces the potentials to be too absorptive at large radii and too transparent at small radii. They thus overestimate the probability of finding the particle in the nuclear interior and, when they are applied to the DWBA treatment of transfer cross sections, the nucleus appears too small. (auth)

27078 SPREADING OF THE GIANT DIPOLE: A SIMPLE ESTIMATE. Bertsch, G. F. (Michigan State Univ., East Lansing). Phys. Lett.; 37B: No. 5, 470-2(27 Dec 1971).

The spreading width of the nuclear giant dipole state is related to the damping width of single-particle states by using the long-wavelength approximation. It is found that $\Gamma_{\text{dipole}} = \frac{4}{9}\Gamma$ single-particle. (auth)

27079 GEOMETRIC CONSEQUENCES OF CHARGE INDEPENDENCE AND MIRROR SYMMETRY IN NUCLEAR REACTIONS. Simonius, M. (Eidgenoessische Technische Hochschule, Zurich). Phys. Lett.; 37B: No. 5, 446-50(27 Dec 1971).

Geometric implications of isospin invariance and mirror symmetry in nuclear reactions are discussed including some remarks on polarization and angular correlation measurements. It is pointed out that existing data on ^{10}B(α,^{7}Li)^{7}Be and ^{12}C(d,^{7}Li)^{7}Be indicate violations of the order of 20%. (auth)

27080 SECONDARY SHELLS IN A SEMI-EMPIRICAL TREATMENT. Schultheis, H.; Schultheis, R. (Univ., Munich). Phys. Lett.; 37B: No. 5, 467-9(27 Dec 1971).

An uncomplicated method to reduce shell energies of arbitrarily deformed nuclei to those of spherical ones is discussed. The shell corrections obtained are similar to the results of the Strutinsky method. (auth)

27081 CORIOLIS EFFECTS IN THE YRAST STATES. Stephens, F. S.; Simon, R. S. (Univ., Munich). Nucl. Phys.; A183: No. 2, 257-84(1972).

The Coriolis effects at high angular momentum were investigated in a system consisting of two (or four) particles in the $i_{13/2}$ orbital coupled to a deformed core. As the angular momentum is increased in this system, the particles tend to decouple from the core and add their angular momenta, ultimately 2j−1 for two particles, directly to that produced by the rotation of the core. In the calculations, enough energy is gained in this partial decoupling so that somewhere between I = 10 and I = 20 these states become lower in energy than those involving just rotation of the initial system. Such a change in the character of the lowest-lying, or yrast, level in this spin region is consistent with existing experimental data on rotational-level spacings and de-excitation cascades. (auth)

27082 EFFECTIVE SINGLE-PARTICLE MAGNETIC MOMENTS AROUND ^{208}Pb. Maier, K. H.; Nakai, K.; Leigh, J. R.; Diamond, R. M.; Stephens, F. S. (Univ. of California, Berkeley). Nucl. Phys.; A183: No. 2, 289-97(1972).

An effective magnetic-moment operator is empirically derived for shell-model states around ^{208}Pb. It reproduces thirteen measured moments to a few tenths of a nuclear magneton, but predicts too high a hindrance for M1 transitions. (auth)

27083 COLLECTIVE TREATMENT OF THE PAIRING HAMILTONIAN. III. NUMERICAL SOLUTIONS FOR THE T = 1 CASE. Dussel, G. G.; Perazzo, R. P. J.; Bes, D. R. (CNEA-Ciclotron, Buenos Aires). Nucl. Phys.; A183: No. 2, 298-318(1972).

Numerical solutions for the T = 1 pairing collective Hamiltonian are obtained. In the first place, the problem of the rigid rotor is solved, for any value of the asymmetry parameter Γ. Secondly, the potential energy surface due to the pairing force is constructed. A model potential, which reproduces the most important features of the pairing-force surface, is diagonalized within the basis corresponding to the six-dimensional harmonic oscillator. Thus, the properties of the collective motion can be followed from the vibrational limit to the different possible rotational limits. (auth)

27084 DETERMINATION OF NUCLEON–NUCLEON POTENTIALS FROM COUPLED PARTIAL WAVES USING THE MARCHENKO THEORY. Benn, J.; Scharf, G. (Univ., Zurich). Nucl. Phys.; A183: No. 2, 319-36(1972).

Local nucleon-nucleon potentials have been calculated from scattering phase shifts using the inverse theory of non-relativistic potential scattering due to Marchenko. This method works without special model assumptions or any given analytic expression of the potential. Combining the results obtained from the T = 1, J = 2 coupled partial waves with previous results from the uncoupled states, the T = 1 nucleon-nucleon potential is now completely calculated in this way. The comparison of this potential with a static one-boson-exchange potential shows that the T = 1 nuclear force can be represented fairly well by the exchange of effective vector (ρ, ω) and scalar mesons (δ, σ_0) and the pion, for distances $r \geq 1$ fm. For $r < 1$ fm the potential becomes strongly singular, indicating that here a potential model has only phenomenological significance. (auth)

27085 INVERSE PROBLEM OF POTENTIAL SCATTERING ACCORDING TO THE DIRAC EQUATION. Weiss, R.; Stahel, W.; Scharf, G. (Univ., Zurich). Nucl. Phys.; A183: No. 2, 337-51 (1972).

The inverse problem of constructing a spherically symmetric potential from its scattering data is solved for the Dirac equation, following the approach of Marchenko for the Schroedinger equation. This theory is well suited for the application to actual scattering processes, since the scattering phase shift and the bound-state data enter in a quite direct and natural manner into the equations. Furthermore, the point x = 0, where the potentials become singular in general, causes no difficulties in this theory. (auth)

27086 SINGLE-PARTICLE MODEL CALCULATION OF TOTAL ENERGY SURFACES IN HEAVY NUCLEI. Maharry, David E.; Davidson, J. P. (Univ. of Kansas, Lawrence). Nucl. Phys.; A183: No. 2, 371-89(1972).

The total energy surfaces for heavy nuclei have been calculated using a double-center oscillator, single-particle potential. The energy surfaces are calculated using the summation method of Nilsson in which the virial term, proportional to $\langle T - V \rangle$, has been calculated explicitly. It is found that this term significantly influences the shape of the energy surface and the calculated height of the fission barrier. The fission barrier for ^{236}U is reduced by 77 MeV with the inclusion of this term. Equilibrium deformations, fission barrier heights and shape isomer excitation energies for nuclei ranging from ^{230}Th to ^{256}Fm are calculated and compared with experimental data as well as other theoretical calculations. It is found that the calculated fission barrier heights are in reasonable agreement with the experimental data if the oscillator parameter, $\hbar\omega_0$, is chosen so that the single-particle level density of the model equals that experimentally observed in the actinide region. Isomeric states, ranging in energy from 2 to 3 MeV, are predicted in nuclei from thorium to curium but are absent in the heavier elements. In thorium the calculations predict that the inner barrier is quite small and spontaneous fission would not likely be observed. In the heavier isotopes of uranium, the lighter isotopes of curium and virtually all of the isotopes of plutonium and americium, the calculated barriers are of nearly equal size. The outer barrier predicted in the heavier curium isotopes is small and observation of spontaneous fission might be quite difficult. It is shown that the energy surfaces are rather insensitive to the Nilsson spin-orbit parameter κ. The quadrupole deformation of the ground state of the range of nuclei investigated is about $\beta_2 = 0.25$ while that of the isomeric state is about $\beta_2 = 0.70$. (auth)

27087 VARIABLE MASSES IN FISSION AND HEAVY-ION COLLISIONS. Lichtner, Peter(Univ., Mainz); Drechsel, Dieter; Maruhn, Joachim; Greiner, Walter. Phys. Rev. Lett.; 28: No. 13, 829-32(27 Mar 1972).

With the use of the cranking formula, the coordinate-dependent mass parameters of the kinetic-energy operator in fission processes and heavy-ion collisions are calculated in the two-center oscillator model. It is shown that the reduced mass and also the classical moment of inertia are obtained for large separations of the fragments. For small separations, however, the mass parameter for the motion of the centers of mass of the fragments is larger than the reduced mass by an order of magnitude. (auth)

27088 INTRASHELL QUARTET EXCITATIONS IN sd-SHELL NUCLEI. Satpathy, L.; Schmid, K. W.; Faessler, Amand (Kernforschungsanlage, Juelich, Ger.). Phys. Rev. Lett.; 28: No. 13, 832-6(27 Mar 1972).

It is proposed that, in addition to the quartet excitations between major oscillator shells (intershell quartet states), quartet excitations within a shell (intrashell quartet states) also exist. A phenomenological quartet shell model is devised to predict the energies of these states. Evidence for such excitations is also found in a microscopic multiconfiguration Hartree–Fock calculation. (auth)

27089 ISOSPIN SPLITTING OF THE GIANT RESONANCE, AND NEUTRON AND PROTON RMS RADII. Leonardi, Renzo (Univ., Bologna). Phys. Rev. Lett.; 28: No. 13, 836-9(27 Mar 1972).

A method for resolving the giant resonance excitation into its isospin components is applied to several nuclei. The relative strengths of the different isospin channels and their energy splittings are calculated. Consistency is found with the existence of the neutron "halo" in heavy nuclei. (auth)

27090 TABLES OF ROTATIONAL WAVEFUNCTIONS d^I_{MK} I ≤ 13 AND I ≤ 25/2. Behkami, A. N. (Pahlavi Univ., Shiraz, Iran. Univ. of Rochester, N. Y.). Nucl. Data, Sect. A; 10: No. 1, 1-47(Sep 1971).

A computer program was developed for calculating the rotational part of the complete wavefunction, $\Psi = \chi_{Int} \cdot \Phi_{vib} \cdot D_{rot}$. Here χ represents the intrinsic motion of the nucleus, which can be expressed in terms of the independent motion of individual particles in the deformed field. The second factor Φ describes the vibrations of the nucleus around its equilibrium shape, while D represents the collective rotational motion of the system as a whole. Calculations of D were made for all polar angles θ from zero up to 90 degrees with steps at 5- to 10-degree intervals, both for integral and half-integral quantum numbers I, M, and K. (auth)

27091 HARMONIC-OSCILLATOR: RELATIVE-COORDINATE TRANSFORMATION COEFFICIENTS. Barber, Arnella (Albany State Coll., Ga); Cooper, Benjamin S. Nucl. Data, Sect. A; 10: No. 1, 49-79(Sep 1971).

Presented here are the transformation coefficients which relate the matrix elements of a two-body interaction obtained on a harmonic-oscillator shell-model basis to matrix elements involving only the relative coordinates of the interacting particles. The tabulated results include all coefficients which arise in the calculation of matrix elements which are diagonal in the unperturbed oscillator energy and which involve shell-model states from the first four oscillator shells. (auth)

27092 TABLE OF ELECTROMAGNETIC M1 REDUCED TRANSITION-PROBABILITY MATRIX ELEMENTS BETWEEN NILSSON STATES IN ODD-A NUCLEI. Browne, E.; Femenia, F. R. (Insitituto de Investigaciones Aeronauticas y Espaciales, Buenos Aires). Nucl. Data, Sect. A; 10: No. 1, 81-106(Sep 1971).

M1 transition matrix elements between all pairs of Nilsson single-particle states with $\Delta N = 0$ and $\Delta K = 0, 1$ for shells N = 0 to 7 and for several nuclear deformations are presented. (auth)

27093 PION PRODUCTION IN NUCLEAR COLLISIONS. Shuster, Milcolm David. College Park, Md.; Univ. of Maryland (1971). 104p. University Microfilms Order No. 72-1678. Thesis.

Current Algebra and the equivalence of the pion field and the divergence of the axial-vector current on the pion mass shell are applied to the study of pion production in nucleon-nucleus and nucleus-nucleus collisions. In the soft-pion limit for nucleon-nucleus collisions a simple form for the pion-production cross section is obtained which when averaged over projectile and target spins is proportional to a single off-mass-shell nuclear amplitude. When all final nuclear states are summed the pion production cross section is found to be proportional to the forward scattering amplitude of the projectile-target system of the energy shell by an amount essentially equal to the pion energy. Non-relativistic dispersion relations are used to continue the production amplitude back to the pion mass shell. The physical amplitude is shown to be given largely by the DWBA approximation with an effective potential for pion production. This potential is applied to the study of pion production in nucleus-nucleus collisions. Expressions are derived for the pion-production cross section which turn out to be sensitive to the real well depth of the nuclear optical well. Some numerical results and a comparison with experiment are presented. (Diss. Abstr. Int., B)

27094 VERIFICATION OF THE WAVE FUNCTION OF THE LIGHT NUCLEI IN THE NUCLEAR REACTION WITH CLUSTERS. Kozlowski, Miroslaw (Univ., Warsaw). Postepy Fiz.; 23: No. 1, 25-45(1972). (In Polish).

Nuclear rearrangement reactions which can be described by direct reactions models are discussed. The reaction amplitude for these reactions is a linear combination of the amplitudes for the direct (e.g., stripping) and exchange modes (e.g., heavy particle stripping). Both modes can be used to obtain cluster configuration and spectroscopic factors. The nuclear reaction mechanism can be predicted when the reduced widths for cluster decomposition of the nuclear wave functions and the location of the singularities of the amplitude are known. The verification of the wave functions of the 1p shell nuclei with (d,^{6}Li) and (p,α) reactions is discussed. (auth)

27095 EXACT SOLUTION OF THE PAIRING PLUS MONOPOLE HAMILTONIAN USING A BOSON REPRESENTATION OF THE GROUP Sp_4. Evans, J. A. (CNEA Ciclotron, Buenos Aires); Kraus, N. Phys. Lett.; 37B: No. 5, 455-9(27 Dec 1971).

A boson representation is given for the group Sp_4 analogous to that of Holstein and Primakoff for R_3. It is shown how this representation provides an exact solution of the pairing-plus-monopole Hamiltonian on two shells and facilitates discussion of the boson expansion. (auth)

27096 ASYMMETRIC FISSION IN THE TWO-CENTER SHELL-MODEL. Slavov, B.; Galonska, J. E.; Faessler, A. (Institut fuer Kernphysik, Juelich, Ger.). Phys. Lett.; 37B: No. 5, 483-6(27 Dec 1971).

A simple two-center shell model (TCS) is proposed for the description of asymmetry in the fission process. Preliminary calculations so far were performed for ^{210}Po, ^{236}U, ^{242}Cm and ^{254}Fm. It turns out that, with the imposition of volume conservation in the simplest way possible, the bare TCS model without inclusion of more sophisticated terms (such as $(l^2-\bar{l}^2)$, pairing corrections, and energy renormalization) yields strikingly good results for the experimental mass ratios of the fission fragments. (auth)

27097 FINITE-RANGE EFFECTS IN (t,p) STRIPPING REACTIONS ON DEFORMED NUCLEI. Spiridon-Candiani, S.; Stihi, G. Rev. Roum. Phys.; 16: No. 10, 1155-70(1971).

A method based on the expansion of the relative functions as a product of a Gaussian function and an expansion in terms of harmonic oscillator wave functions is applied to (t, p) stripping reactions on deformed nuclei. An explicit expression for the cross section of this process with finite forces of Gaussian type is given. (1 figure) (auth)

27098 COMPLICATION IN THE STRUCTURE OF THE NUCLEAR STATE WITH INCREASE IN THE EXCITATION ENERGY. Solov'ev, V. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 666-77(Apr 1971). (In Russian).

Basic formulas are given for calculating the interaction of quasiparticles with phonons, which describe the vibrational states of even-even nuclei. This development may be further used to gain an understanding of the occurrence of splitting of the single-particle states, and the increase of the level density with increase of excitation energy. Wave functions are introduced which contain a large number of components with different numbers of quasiparticles. The probability of α, β, and γ-transitions may be described with these wave functions. The treatment of α-transitions with resonances is shown for basic and single-particle states of ^{144}Nd. (K.S.W.)

27099 γ-SPECTROSCOPY OF NUCLEI UNDER NUCLEAR MAGNETIC RESONANCE. Pokazan'ev, V. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 756-8(Apr 1971). (In Russian).

The effect of radiofrequency transitions of excited nuclei on the characteristics of γ radiation was studied. The use of γ radiation for NMR studies of excited nuclei is possible because the properties of the γ radiation and fixed by the angular state of the system, which in turn is readily altered by an rf field of frequency equal to the frequency of the disintegration of the nuclear states. A theoretical treatment is offered which involves resonant γ-fluorescence, circularly polarized radiation, and Zeeman splitting. (K.S.W.)

27100 PROPERTIES OF NUCLEI REMOVED FROM THE TROUGH OF β-STABILITY. Berlovich, E. E. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 774-85(Apr 1971). (In Russian).

Some effects are examined which are characteristic of nuclei which have been removed from the β-stability trough: structural features of these nuclei, two-neutron disintegration near the boundary of neutron stability, delayed disintegration with ejection of ^{3}He and ^{3}H, delayed fission, double β-decay, the contribution of higher orders in β-transitions of the $0^+ \rightarrow 0^+$ type, and synthesis of superheavy elements during supernova explosions. (tr-auth)

27101 COLLECTIVE INTERPRETATION OF THE CONSERVATION LAWS AND THE DESCRIPTION OF ROTATION OF A DEFORMED NUCLEUS. Mikhailov, V. M. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 794-805(Apr 1971). (In Russian).

The study of deformed nuclei shows that there frequently exist two types of motion within them: the rotation of some inner system of coordinates associated with the nucleus, and motion of nucleons within this system. The special features of the discussion are: the insertion of extraneous variables and some properties of parametric groups, the construction of a unitary transformation for n-parametric groups, a definite form for a transformation operator for a physical quantity, the rotational spectrum and the moment of inertia of deformed nuclei. (K.S.W.)

27102 DETERMINATION OF SPECTROSCOPIC FACTORS FROM RESONANCE PROTON SCATTERING DATA WITH EXCITATION OF ANALOG STATES. Devyatko, Yu. N.; Urin, M. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 810-22(Apr 1971). (In Russian).

A number of spectroscopic factors were determined in connection with elastic and nonelastic scattering of protons with excitation of isobaric analog resonances. Formulas are suggested for the determination of the "natural" width of analog states from experimental data, and the single-particle proton width of analog states. Another factor treated by the theoretical approach is the determination of spectroscopic factors for certain states of ^{48}Ca, ^{88}Sr, and ^{90}Zr. A comparison with other approaches is made. (K.S.W.)

27103 CONFIRMATION OF THE T-INVARIANCE OF STRONG AND ELECTROMAGNETIC INTERACTION IN PAIR CONVERSION. Lobov, G. A.; Trukhan, A. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 859-60(Apr 1971). (In Russian).

Interaction models had been propounded for the T-noninvariant decay of the long-lived neutral K-meson $K_L^0 \rightarrow \pi^+\pi^-$, and these models successfully predicted the T-noninvariance effect in electromagnetic interactions of nuclei having an order of magnitude of 10^{-3}. The T-noninvariant angular correlation in interval conversion with electron-positron pair emission was examined for polarized nuclei. (K.S.W.)

27104 T-NONINVARIANT ANGULAR CORRELATIONS OF CONVERSION ELECTRONS AND γ QUANTA. Vlasov, V. G. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 4, 867-9(Apr 1971). (In Russian).

One of the possible manifestations of T-noninvariance in strong and electromagnetic interactions is the existence of T-noninvariant angular correlations in double cascade transitions of polarized nuclei. A theoretical treatment of this subject is presented, re-

sulting in an expression for the correlation function in connection with photon and electron conversion transitions, respectively. (K.S.W.)

27105 SPECTRUM OF RANDOM MATRICES. Pastur, L. A. (Physical-Technical Inst. of Low Temperatures, Kharkov). Teor. Mat. Fiz.; 10: No. 1, 102-12(Jan 1972). (In Russian).

The distribution of eigenvalues in some ensemble of random matrices, which contains, in particular, the ensemble applied by Wigner for statistical description of energy levels in heavy nuclei, is studied. It is shown that the distribution function of eigenvalues normalized by the factor N (the order of the matrices) becomes nonrandom when $N \to \infty$ and can be found by solving a definite functional equation. (auth)

27106 SUM RULES IN PERTURBATION THEORY. Simenog, I. V. (Inst. of Theoretical Physics, Moscow). Teor. Mat. Fiz.; 10: No. 3, 360-9(Mar 1972). (In Russian).

In the framework of perturbation theory for the three- and four-particle systems the sum rules are obtained for the expectations of physical quantities in the ground state. These sum rules make it unnecessary to use the explicit form of the higher excited states of the nonperturbed problem. They can also be used for calculating energies, form factors and mean-squared radii of ground states in the case of three- and four-particle nucleon systems. (auth)

27107 NEUTRON-MATTER EQUATIONS OF STATE. Miller, M. (Univ. of Illinois, Urbana. Northwestern Univ., Evanston, Ill.); Woo, C. W.; Clark, J. W.; Ter Louw, W. J. Nucl. Phys.; A184: No. 1, 1-12(1972).

The equation of state of dense matter is essential to the theoretical prediction of the structure of neutron stars on the global as well as local scale. Two parallel microscopic calculations of the equation of state of a uniform extended system of neutrons interacting by the Reid potential are presented. The first is based on the ordinary Jastrow method in two-body approximation; the second, on the Wu–Feenberg version of Jastrow theory, which sums higher-order contributions. The good agreement of the two calculations, to quite high density, indicates that, for the simple monotonic correlation factor assumed, a prominent class of higher-order (three-body, four-body, ...) cluster contributions is relatively unimportant in dense neutron matter. (2 tables) (auth)

27108 ANALOG RESONANCES IN ISOSPIN-FORBIDDEN DEUTERON CHANNELS. de Toledo Piza, A. F. R. (Massachusetts Inst. of Tech., Cambridge. Univ., Sao Paulo, Brazil). Nucl. Phys.; A184: No. 1, 303-20(1972).

The isospin-forbidden deuteron decay of isobaric analog resonances is examined, and estimates of the contributions of a number of different deuteron escape mechanisms are given. The dominant contributions are found to be associated with the coupling of the deuteron to isospin-allowed proton channels. Nonstatistical compound effects are small. (6 figures, 2 tables) (auth)

27109 SUM RULES AND TWO-PARTICLE UNITS IN THE ANALYSIS OF TWO-NEUTRON TRANSFER REACTIONS. Broglia, R. A. (Univ. of Copenhagen. Brookhaven National Lab., Upton, N. Y.); Riedel, C.; Udagawa, T. Nucl. Phys.; A184: No. 1, 23-49(1972).

The problem of two-particle units and sum rules in two-neutron-transfer reactions is discussed. By using (t,p) data on ^{16}O, ^{40}Ca, ^{48}Ca, ^{118}Sn, ^{204}Pb, ^{206}Pb, ^{207}Pb, and ^{208}Pb targets and available model wave functions, a universal value of the absolute normalization factor D_0^2 is obtained. By utilizing this value the adequacy of the shell-model subspace used in generating the wave functions is studied. With the aid of two-particle units conveniently defined in terms of D_0^2, enhancement factors are calculated for all transitions analyzed and a quantitative definition of enhanced cross sections is obtained. The relation between the two-particle units introduced here and the Weisskopf units used in connection with electromagnetic reduced transition probabilities is pointed out. (4 figures, 11 tables) (auth)

27110 METHOD FOR FAST CONVERGENCE OF THE REACTION MATRIX. Satpathy, R. K. (Sambalpur Univ., India); Mukherjee, Suprokash. Nucl. Phys.; A184: No. 1, 285-302 (1972).

The reference reaction matrix t^R for a local potential is expanded as a series in terms of the difference between this potential and an auxiliary potential. The latter is chosen to be a nonlocal separable potential, so that its matrix elements are summed up exactly. By suitably varying the parameters of the separable potential it is possible to get a fast convergence of the matrix elements of the series. Calculations are performed with a Gammel–Thaler potential to show the convergence rate. The method is an improvement over the convergence rate of the modified Born series of Bethe et al., and can be applied to nuclear matter calculations with more realistic potentials. (1 figure, 3 tables) (auth)

27111 ANALYSIS OF E2 RADIATION WIDTHS FOR HIGHLY EXCITED NUCLEAR LEVELS. Fubini, A.; Oliva, P. R.; Prosperi, D. (CNEN, Rome). Lett. Nuovo Cim.; 3: No. 10, 401-6 (4 Mar 1972).

E2 radiation widths for highly excited nuclear energy levels are analyzed by correlating the E2 strength function at the neutron binding energy with the tail of the giant quadrupole resonance; the E2 photoabsorption cross section is obtained from a model developed for heavy nuclei in the framework of the Fermi gas theory. An order-of-magnitude expression for the average widths of levels near the binding energy is found and compared with experiment. (3 figures) (R.W.R.)

27112 CALCULATION OF ONE-PARTICLE FRACTIONAL PARENTAGE COEFFICIENTS FOR NUCLEUS WAVE FUNCTION IN THE UNITARY SCHEME FOR ONE-EXCITED $U_{3(n-1)}$ STATES. Yankauskas, K. I.; Petrauskas, A. K. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 11: No. 3, 361-99(1971). (In Russian).

The recurrent method of calculation of one-particle fractional parentage coefficients for one-excited $U_{3(n-1)}$ states with the number of quanta $E_{min} + 1$ is described. The numerical tables of fractional parentage coefficients for these states for nuclei with $5 \leq n \leq 10$ are presented. (auth)

27113 METHOD OF CALCULATION OF ONE-PARTICLE ORBITAL FRACTIONAL PARENTAGE COEFFICIENTS FOR NUCLEUS WAVE FUNCTION IN THE UNITARY SCHEME AND ITS APPLICATION TO THE CONSTRUCTION OF DENSITY MATRIX. Petrauskas, A. K.; Yankauskas, K. I. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 11: No. 3, 349-59(1971). (In Russian).

The method of calculation of one-particle orbital fractional parentage coefficients for the excited $U_{3(n-1)}$ states is outlined. The general expressions of these coefficients for the ground $U_{3(n-1)}$ states for nuclei with $n \leq 16$ are presented. The construction of the one-particle density matrix is discussed and the formula for the SU_3-invariant density matrix is given. (auth)

27114 ELECTRON SCATTERING FROM COMPLEX NUCLEI. PART B. Ueberall, Herbert. Pure and Applied Physics, Volume 36. A Series of Monographs and Textbooks. New York; Academic Press Inc. (1971). 413p. $21.00.

Part B has chapters on inelastic electron scattering, scattering to the continuum, and special topics. Special topics include isospin effects, dispersion effects, sum rules and correlations, and meson exchange effects and meson production. Appendices clarify some of the mathematics used in the text. A list of review articles and books is included. A thorough list of references and a subject index are also provided. (J.W.R.)

27115 NUCLEAR STRUCTURE STUDIED FROM WEAK AND RELATED PROCESSES. Morita, Masato (Osaka Univ.); Yamada, Masami; Fujita, Jun-ichi; (and others). Progr. Theor. Phys. (Kyoto), Suppl.; No. 48, 41-100(1971).

A review is made on the nuclear structure studied from weak and related processes. The nuclear beta decay, muon capture, electron scattering and internal conversion are discussed. (auth)

27116 INVESTIGATIONS ON THE EXTERNAL PROBLEM OF ALPHA DECAY. Ixaru, L. G. (Inst. of Atomic Physics, Bucharest). Can. J. Phys.; 49: No. 23, 2947-61(1 Dec 1971).

Two of the approximations currently used in calculating the barrier penetration factor of the R-matrix theory of alpha decay, the JWKB approach and the neglect of alpha particle size, are examined to determine their contribution to the major discrepancies between theoretical and empirical absolute decay rates. In the daughter nucleus surface region, the JWKB approximation is shown to be fairly accurate except in an interval of about 1 fm thickness centered at the inner turning point. The neglect of alpha particle size is also found to be an accurate approximation. Based on these results and those of other papers on the theory of alpha decay, it is suggested that the discrepancies could be seriously diminished only by renouncing the standard view of the alpha decay mechanism. A new decay model is introduced, and the external problem corresponding to it is considered. An enhancement of the penetrabilities by a factor of 30 to 40 results. Some arguments in favor of this model are also given. (E.M.T.) (Canada)

27117 NEITRONY. IZDANNE VTOROE, PERERABOTANNOE. (Neutrons. Second Edition, Revised). Vlasov, N. A. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko-Matematicheskoi Literatury (1971). 552p.

An introduction is given to the basic problems of contemporary neutron physics. Attention is focused on the fundamental properties of the neutron: mass, methods of decay, charge, spin, magnetic and electric moments, and neutron abundance in nature. Numerous examples are discussed for each of the types of neutron interaction: (α,n), (d,n), (p,n), and (γ,n). Techniques for observing

neutrons, their interaction with matter (capture, scattering, fission), their moderation and absorption, and wave properties of neutrons are thoroughly treated. 469 references. (K.S.W.)

27118 TARGET THICKNESS CORRECTION IN POLARIZED NEUTRON-AND-TARGET EXPERIMENTS. Honzatko, J.; Kajfosz, J. (Nuclear Research Inst., Rez, Czech.). Czech. J. Phys.; 22: No. 1, 38-41(1972).

Factors influencing the effective degree of neutron beam polarization in thick polarized targets are discussed. The calculation of correction formulas is outlined. (auth)

27119 BACKWARD BENDING IN SPHERICAL NUCLEI. Marshalek, E. R. (Technische Univ., Munich). Phys. Lett.; 38B: No. 6, 367-70(20 Mar 1972).

The "backward bending" behavior in the plot of moment of inertia versus rotational frequency recently observed at high spin in a deformed nucleus also seems to occur for the quasirotational bands of some spherical nuclei at low spins. The plausibility of a connection with Coriolis antipairing is discussed for the latter case. (auth)

27120 HIGH ENERGY FISSION AND SPALLATION SYSTEMATICS FOR TRANS-BISMUTH NUCLEI. Schramm, D. N. (California Inst. of Tech., Pasadena). Phys. Lett.; 38B: No. 6, 363-6 (20 Mar 1972).

A semi-empirical formula has been developed to estimate high energy (>0.6 GeV) fission cross sections. This formula has then been used with a Rudstam-type spallation formula to estimate spallation yields for trans-lead nuclei. (auth)

27121 CONTRIBUTION OF TWO-PARTICLE LADDER AND RPA TERMS TO THE EFFECTIVE INTERACTION IN A = 18 NUCLEI. Barrett, B. R. (Univ. of Arizona, Tucson). Phys. Lett.; 38B: No. 6, 371-5(20 Mar 1972).

Two-particle ladder and RPA terms are included in the perturbation expansion for the effective interaction θ in A = 18 nuclei through third order in the reaction matrix. Although the possibility of convergence is improved, this improvement is questionable, because of double counting. Ways for improving the calculation of θ are discussed. (auth)

27122 SIMPLIFIED GENERATOR COORDINATE TREATMENT FOR PAIRING CORRELATIONS. Sorensen, R. A. (Carnegie-Mellon Univ., Pittsburgh. Research Inst. for Physics, Stockholm). Phys. Lett.; 38B: No. 6, 376-8(20 Mar 1972).

A simple approximation for treating the pairing Hamiltonian, based on a generator coordinate treatment of the BCS method, is demonstrated. The new feature is a partial projection to fixed particle number which still retains the simplicity of the BCS equations. (auth)

27123 FEATURES OF THE π NUCLEAR SCATTERING AT LOW ENERGY. Ericson, M. (Univ., Lyon); Krell, M. Phys. Lett.; 38B: No. 6, 359-62(20 Mar 1972).

The behavior of π nuclear scattering at low energies (<100 MeV) is discussed. It is predicted that in relatively light nuclei the s wave interaction might show a sign change from repulsion to attraction due to the growing influence of the non local interaction. It is possible that size resonance exists in the s and p wave partial amplitudes. (auth)

27124 CALCULATION OF TRINUCLEON BINDING ENERGIES AND CHARGE FORM FACTORS USING THE BOUNDARY CONDITION MODEL. Kim, Y. E.; Tubis, A. (Purdue Univ., Lafayette, Ind.). Phys. Lett.; 38B: No. 6, 354-8(20 Mar 1972).

Trinucleon binding energies and charge form factors are calculated using the Faddeev formalism and a two nucleon s-wave interaction given by the boundary condition model. The calculated binding energy is compared with that obtained using Brayshaw's modification of the Faddeev equations. (auth)

27125 EXCHANGE CURRENTS IN PARITY NON CONSERVING ELECTROMAGNETIC TRANSITIONS. McKellar, B. H. J. (Michigan State Univ., East Lansing). Phys. Lett.; 38B: No. 6, 401-4(20 Mar 1972).

It is shown that exchange currents do not contribute significantly to parity non-conserving transitions of the electric multipole type. (auth)

27126 CLOSURE APPROXIMATION IN THE STUDY OF MUON CAPTURE BY NUCLEI. Do Dang, G. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Lett.; 38B: No. 6, 397-400(20 Mar 1972).

A method is developed which allows one to calculate the total capture rate of muons by nuclei in a modified closure approximation in such a way that the result is approximately independent of the average neutrino energy adopted. (auth)

27127 NOTE ON THE DISAPPEARANCE OF SHELL EFFECTS WITH EXCITATION ENERGY AND THE STRUTINKSI SMOOTHING PROCEDURE. Moretto, L. G. (Univ. of California, Berkeley). Phys. Lett.; 38B: No. 6, 393-6(20 Mar 1972).

The energy dependence of the nuclear entropy at high excitation energy is calculated for non equidistant and shell models. The deviation from a linear dependence in the square of the entropy is shown. The relation between the Strutinski and the statistical averaging of the spectrum is discussed. (auth)

27128 PRECISION DETERMINATION OF ATOMIC MASSES AND THE EINSTEIN MASS–ENERGY RELATION. Wapstra, A. H. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 151-4(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The conversion constant between atomic mass and energy units is calculated in a least squares adjustment of atomic mass doublets and nuclear reaction energies. The agreement with the same factor as derived from Einstein's relation is satisfactory and comparable in precision with, but not independent of the value as derived from measurement of the Compton wavelength of the electron. Measurements are proposed that allow an independent check of Einstein's mass-energy relation. (auth)

27129 MICROSCOPIC APPROACH TO $_{\Lambda}Be^{9}$. Rayet, M. (Univ., Brussels). Nucl. Phys.; B38: No. 2, 387-96(1972).

The binding energy of the hypernucleus $_{\Lambda}Be^{9}$ is calculated by the variational principle with a determinantal single particle wave function which exhibits the $\alpha-\alpha-\Lambda$ structure of $_{\Lambda}Be^{9}$. Effective N–N forces are used and an effective Λ–N force is determined from the $_{\Lambda}He^{5}$ binding energy. Size and shape polarization of the Λ particles is determined by the variational procedure. Two orbitals of opposite parity are considered for the Λ particle. Their energies are discussed as well as the nuclear distortions induced by the Λ particle. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

27130 (NP-19248) WILLS PLASMA PHYSICS DEPARTMENT TWENTY-SECOND SIX MONTHLY PROGRESS REPORT, JULY 1-DECEMBER 31, 1971. (Sydney Univ. (Australia). School of Physics). 9p. (PR-22). Dep. NTIS (U. S. Sales Only).

An account is given of research being carried out within the department. Particular mention is made of plasma sources, hydromagnetic ionizing fronts, plasma decay, rotating plasmas, cyclotron harmonic waves, hydromagnetic waves, laser diagnostics and far infrared. Recent staff publications are listed. (auth)

27131 PLASMA PHYSICS INDEX. VOLUME 7, NO. 2, 1972. Bibliography, Author Index, Subject Index. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 150p.

This listing contains 478 references on various aspects of plasma physics. (M.O.W.)

Confinement and Heating

Refer also to abstract 27195.

27132 (AD-734258) EXPERIMENTAL STUDIES ON THE INJECTION AND CONTAINMENT OF ELECTRON CLOUDS IN A TOROIDAL APPARATUS. Daugherty, J. D.; Eninger, J.; Janes, G. S. (Avco-Everett Research Lab., Everett, Mass.). Oct 1971. Contract F44620-70-C-0067. 52p. (AERL-RR-375; AFOSR-TR-71-3101). NTIS.

Studies were conducted on the production and containment of electron-rich plasmas in toroidal geometries. Electron densities in excess of 3×10^9 cm^{-3} were produced and contained in toroidal magnetic fields for as much as 10 ms. Studies also indicate that the optimum production of large electron densities without excessive wall bombardment should be attained with a triode-type injection configuration wherein the energy investment in waves and electron temperature is minimized. This configuration should be located near the major axis of the apparatus. Containment is terminated when the ion density reaches about 20% of the electron density. The ions are shown to be produced from atoms released from the walls by electron bombardment associated with inefficiencies in the electron-injection process. A technique for controlling this effect, which involves electron pre-bombardment of the walls, is described. (auth)

27133 (EUR-CEA-FC-611) COMPARISON OF DECA II MIRROR MACHINE RESULTS WITH A FOKKER-PLANK COMPUTER CODE. Kesner, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Sep 1971. 27p. Dep. NTIS (U. S. Sales Only).

A program using a Fokker-Planck code is used to numerically investigate the behavior of a plasma confined by magnetic mirrors. The Fokker-Planck equation is resolved for a plasma in a square well. The term corresponding to the plasma source (a high-energy neutral beam) is eliminated from the original program, and a term corresponding to plasma losses due to charge exchange resulting from a time-varying residual pressure is included. The axial distribution of the plasma density in a magnetic field with a variable geometric configuration is studied using the angular distribution obtained for the square well as a base. (France)

27134 (KHFTI-70-80) STUDY OF THE EFFECT OF A "PLASMIC DIAPHRAGM" ON THE ELECTRICAL DRIFT OF A PLASMIC STREAM INJECTED INTO THE TOROIDAL MAGNETIC FIELD WITH A DIVERTER. Zykov, V. G.; Karpukhin, V. I.; Rudnev, N. I.; Tolok, V. T. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1971. 17p. (In Russian). Dep. NTIS (U. S. Sales Only).

The basis of the apparatus used in this study was the stellarator "Sirius" (Khar'kov), equipped with a plasma injector. A semitorus whose large radius was 41 cm was attached to the divertor of the stellarator. The internal diameter of the vacuum chamber was 7 cm, and induction coils provided a magnetic field of 10 kOe. A comparative study of plasma drift was made in the toroidal magnetic field from the divertor or the solenoidal configuration at the entrance. The polarizing interaction of the coaxial plasma streams in the magnetic field of a toroidal solenoid was investigated. (K.S.W.)

27135 (KHFTI-71-6) STUDY OF HIGH-FREQUENCY HEATING OF A DENSE PLASMA IN THE TOROIDAL MAGNETIC FIELD. Ovchinnikov, S. S.; Kalinichenko, S. S.; Kurilko, P. I.; Shvets, O. M.; Tolok, V. T. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1971. 37p. (In Russian). Dep. NTIS (U. S. Sales Only).

The general features of the toroidal apparatus "Omega" are described, with its provision for slow heating of the plasma in a closed magnetic trap by a high-frequency field. The input of high-frequency power into a plasma held in a toroidal trap within a metallic chamber was one of the primary goals of the study; the other was the effective heating of plasma during thermalization of the energy of the exciting wave. (K.S.W.)

27136 (N-71-37284) LASER HEATING OF A STATIONARY PLASMA. Steinhauer, Loren Clifford (Washington Univ., Seattle). 1970. 244p. (NASA-CR-122087). NTIS.

Heating of plasma by laser beams is discussed. The plasma is taken to be a one-dimensional, fully ionized gas. The initial density and temperature profiles are arbitrary to the extent that a fully ionized gas is a valid assumption. The plasma is assumed to be a dense ideal gas mixture of electrons and ions such that there is charge neutrality at every point for all times. (auth) (STAR)

27137 (NP-19245) TURBULENT HEATING OF A PLASMA BY A HIGH ELECTRIC FIELD. Rijnhuizen Report 71-67. Piekaar, H. W. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Dec 1971. 94p. Dep. NTIS (U. S. Sales Only).

The turbulent heating of a hydrogen plasma column by the passage of an axial current is studied. The plasma is produced by a gas-fed hollow-cathode discharge. The plasma column has a length of 0.65 m and a diameter of 15 mm, and is contained in a simple magnetic mirror with a mirror ratio of 2 and a field strength of 0.4 T in the mirrors. The condition for the onset of the turbulent heating, i.e., an electric field exceeding the runaway field strength is imposed when a capacitor of 1.8 μF at 15 to 40 kV is discharged across the length of the plasma column. The corresponding electric field strengths are between 20 and 60 kV m^{-1}. The turbulent states can persist up to 5 μs and can be ended at a preset time by means of a crowbar switch. In this way the time evolution of the heating process can be followed. It is observed that the plasma column expands to a diameter of 3.4 cm and that the newly formed plasma column is heated integrally. The drift velocity of the electrons only slightly exceeds the ion-sound velocity at the final stages of the heating. Electron temperatures are in the order of 500 to 1000 eV. The microwave radiation is measured near the ion and electron plasma frequencies. It is concluded that the two-stream instability and the ion-acoustic instability are responsible for the observed plasma heating. It is found that the distribution function of the heated ions is a Maxwellian and that the bulk of the ions is heated. The ion temperatures observed vary from 200 to 900 eV for densities of 10^{20} m^{-3}. It is inferred that the energy content increases quadratically with the applied voltage. Energy contents of 2×10^{23} eV m^{-3} are measured. A superthermal radiation level of at least 1% of the energy content is present. Heating efficiencies from 4 to 15% are reported. (auth)

27138 (NYO-1480-184) CLASSICAL PLASMA DIFFUSION. Grad, Harold (New York Univ., N. Y. Courant Inst. of Mathematical Sciences). Nov 1971. Contract AT(30-1)-1480. 31p. (MF-69; CONF-711016-10). Dep. NTIS.

From Conference on plasma theory; Kiev, USSR (19 Oct 1971).

Macroscopic plasma diffusion as governed by the simplest form of Ohm's law for small mean free path is a very complex phenomenon which is by no means described by the classical "$1/B^2$" formula. Diffusion across a magnetic field is, in general, a nonlocal, nonlinear, and transient combination of skin effect, field diffusion, plasma diffusion, and singular convection. It turns out that several orders of magnitude are at stake in balancing these competing effects. There is probably at least as large an unknown factor to be determined in the equivalent calculation still to be done with a kinetic physical model. The basic question of when transport coefficients can be calculated as averages over flux surfaces is examined. (auth)

27139 ELECTROSTATIC-INERTIAL PLASMA CONFINEMENT. Dolan, T. J.; Verdeyen, J. T.; Meeker, D. J.; Cherrington, B. E. (Univ. of Illinois, Urbana). J. Appl. Phys.; 43: No. 4, 1590-1600(Apr 1972).

Electrostatic-inertial plasma confinement consists of trapping charged particles in potential wells of the electric field, which

are created by ions or electrons injected radially inwards into a hollow sphere or cylinder. Theoretical expressions are derived for the potential and particle densities as functions of radius, grid voltage, and current. A neon plasma is produced in cylindrical geometry, using a grid 4 cm in diameter and 16 cm long. Using the laser heterodyne technique at 0.6401 and 0.6328 μ, the density of neon atoms in the $1s_5$ metastable state is measured (10^9 to 10^{12} cm^{-3}) as a function of radial position, time, grid current (20-μsec pulses of up to 4 A), grid voltage (0.2 to 3.0 kV), gas pressure (0.001 to 0.01 torr), and grid mesh spacing, and compared with theoretical predictions. The peak electron density is 10^{11} cm^{-3}. When the spacing between grid wires is larger than 1 mm, a decrease in metastable density, attributed to the presence of a plasma sheath around the grid wires, is observed. The radial variation of plasma light intensity is compared with the theoretical radial distribution of electron density. (auth)

27140 INVESTIGATION OF BEAM GENERATED, ION HEATING RF WAVES IN A NONBEAM FORMED CYLINDRICAL PLASMA. Beeth, Donald Richard. Houston, Tex.; Univ. of Houston (1971). 71p. University Microfilms Order No. 72-5343.

Thesis.

An unmodulated 3- to 4-kV electron beam was injected axially into mirror-confined $>10^{12}/cm^3$ He^+ and H_2^+ plasmas. The plasmas had a continuously decreasing radial density and the experiment was performed in the high-density regime, $\Pi_e^2/\Omega_e^2 \gg 1$ (Π_e is the electron plasma frequency and Ω_e is the electron cyclotron frequency). Energetic ions above 300 eV were observed, demonstrating ion heating in the high-density regime. The energetic ions were associated with a strong standing wave radial field inside the plasma column. Cold plasma theory does not predict reflections from a declining density boundary; however, the observed standing waves imply the existence of a reflecting boundary. The wave frequency was near the ion plasma frequency and was found to be ion-mass-independent. This is consistent with a resonant plasma column model based on a cold, magnetized, high-density plasma with waves propagating nearly transverse to the magnetic field. (Diss. Abstr. Int., B)

27141 RESONANT ABSORPTION OF LASER LIGHT BY PLASMA TARGETS. Freidberg, J. P.; Mitchell, R. W.; Morse, R. L.; Rudsinski, L. I. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett.; 28: No. 13, 795-9(27 Mar 1972).

It is proposed that a resonant mechanism should cause significant absorption of energy from intense laser pulses in plasma targets and that the energy should be deposited in such a way as to form a very non-Maxwellian high-temperature tail on the electron velocity distribution. (auth)

27142 ION LOSS IN A MIRROR SYSTEM WITH A RADIAL ELECTRIC FIELD. Turikov, V. A. (Univ. of International Friendship, Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 10, 1624-6(Apr 1972).

Translated from Zh. Tekh. Fiz.; 41: No. 10, 2050-2(Oct 1971).

The Coulomb ion loss in a mirror system with a radial electric field is evaluated by a numerical solution of the Landau equation in the diffusion approximation. The ion velocity spectrum is found and the dependence of the confinement time on the electric field is studied. (auth)

27143 THREE-DIMENSIONAL PLASMA DIFFUSION IN A VERY STRONG MAGNETIC FIELD. Montgomery, David (Univ. of Iowa, Iowa City); Liu, C.-S.; Vahala, George. Phys. Fluids; 15: No. 5, 815-19(May 1972).

The thermal equilibrium coefficient of spatial diffusion transverse to a strong uniform dc magnetic field is calculated for a fully ionized plasma. The particles are assumed to move transverse to the field only as a consequence of the $E \times B$ drift, but to move freely parallel to it. The particles interact only electrostatically. The calculation is done at large, but fixed and finite, plasma volume. It is shown that, as $B \to \infty$, the leading term of the coefficient of transverse spatial diffusion falls off as $O(1/B)$, but contains a multiplicative factor which goes to zero as the plasma volume becomes infinite. The method of calculation fails for unbounded plasmas. (auth)

27144 LASER HEATING OF PLASMA BY HEAT CONDUCTIVITY MECHANISM IN THE CASE OF SPHERICAL AND CYLINDRICAL WAVES. Kaliski, S. (Inst. of Fundamental Technical Problems, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 20: No. 1, 35-40(1972).

Closed-form solution of the problem of propagation of a spherical (cylindrical) thermal wave under the conditions of laser heating of plasma is obtained, assuming thermal-type heating and making use of the modified, quasi-averaged method of momentums. This solution is valid at the initial stage of the heating process of plasma, if the effects of hydrodynamic expansion of plasma are negligible. The form of these solutions allows one to obtain a similar approximate solution in the case in which the recovery of nuclear fusion energy is taken into account. (auth)

27145 LASER HEATING OF PLASMA, THE FUSION ENERGY BEING TAKEN INTO CONSIDERATION IN THE CASE OF A PLANE THERMAL WAVE: A SIMPLIFIED SOLUTION. Kaliski, S. (Inst. of Fundamental Technical Problems, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 20: No. 1, 41-7(1972).

The problem of laser heating of plasma, based on the thermal-conductivity mechanism, is solved in an approximate manner, recovery of the nuclear fusion energy being taken into account. A plane thermal wave is considered by modifying the second equation of momentums. This enables one to obtain a closed form solution in a much simpler form. If the nuclear fusion energy is disregarded, the modified solution coincides within constant terms (the difference being that of several percents) with the solution obtained earlier by the method of momentums. (auth)

Diagnostics

Refer also to abstract 26357.

27146 (INR-P-1355) MEASUREMENT OF TEMPERATURE BY RECORDING THE ABSOLUTE LINE INTENSITY FOR APPARENT INCREASE OF PLASMA OPTICAL THICKNESS. Suckewer, Szymon (Institute of Nuclear Research, Warsaw (Poland)). 1971. 9p. Dep. NTIS (U. S. Sales Only).

The possibilities of measurements of temperature by recording absolute line intensity, using the apparent increase of optical thickness of a plasma placed between two parallel mirrors are discussed. The analysis of spectral-line contours for increasing optical thickness is given. The diagram of the measuring instrument is discussed. (auth)

27147 LASER INTERFEROMETRIC METHOD FOR ELECTRON CONCENTRATION MEASUREMENTS IN STABILIZED PLASMAS. Meubus, Paul; Fortin, Marc (Univ. of Quebec, Chicoutimi). Can. J. Chem. Eng.; 49: No. 6, 797-803(Dec 1971).

An interferometric means for measuring electron concentrations between 10^{12} and 10^{16} electrons per cm^3 in a stabilized ionized medium is presented, and an argon plasma is used to illustrate the method. The interferometer is a 100-mW He–Ne laser emitting at 6328 Å and 3.39 μ, and a movable mirror is used to obtain the interferometric fringes required for calculation of the electron concentrations in the plasma. The method uses the interesting feature of the He–Ne laser that both emissions at 6328 Å and 3.39 μ originate at the same upper level, so that variations in the 3.39 μ emission modulate the visible light (6328 Å) output. This property has been used by a number of authors for measurements on plasmas in transient conditions; this paper presents an application of the method for stabilized plasmas, thus broadening the field of application. (auth) (Canada)

27148 LANGMUIR-SHEATH THICKNESS AS OBSERVED BY ION ACOUSTIC WAVES AND A HOT PROBE. Widner, M. M.; Alexeff, I.; Jones, W. D. (Oak Ridge National Lab., Tenn.). J. Appl. Phys.; 43: No. 4, 1532-4(Apr 1972).

Ion acoustic waves and an electron-emitting hot probe are used to measure Langmuir sheath thickness as a function of negative electrode voltage. The thickness varies as voltage to the $^3/_4$ power, as expected, which suggests diagnostics for plasmas based upon these methods. (auth)

27149 SPECTROSCOPIC STUDY OF THE EARLY AFTERGLOW OF A RECOMBINING HELIUM PLASMA. Stevefelt, J. (Aktiebolaget Atomenergi, Studsvik, Sweden); Robben, F. Phys. Rev., A; 5: No. 3, 1502-15(Mar 1972).

The afterglow of a 1.3-A, 1.5-μsec-duration discharge in helium at 11 torr was studied in some detail during the times 15 to 35 μsec after the discharge pulse. Spectroscopic measurements were used to obtain the number densities of excited atomic and molecular states; the conductance of the plasma column was determined from simultaneous electric field and current measurements; and a 10-μsec current pulse was used to selectively heat the electrons, thus disturbing some of the afterglow processes. The atomic and molecular ion densities and the electron temperature, obtained from the spectroscopic measurements, were in good agreement with the plasma conductance and field strengths. The inferred recombination rate favors the recent calculations of Mansbach and Keck over the Bates, Kingston, and McWhirter calculations

of the collisional radiative-recombination rate. The rate of conversion of atomic into molecular ions was dominated by associative ionization of excited atomic states, and good agreement was obtained by including this process with other known processes. (auth)

27150 SPHERICAL AND CYLINDRICAL ELECTRIC PROBES IN A CONTINUUM FLOWING PLASMA. David, Thomas Sunderam. Ithaca, N. Y.; Cornell Univ. (1971). 139p. University Microfilms Order No. 72-8837.

Thesis.

Theories are presented for electric probes at large negative potential immersed in a slightly ionized continuum flow. The theories apply to spherical probes and to cylindrical probes transverse to the flow. The electric sheath can have a thickness of the order of the probe radius. The cases of both large and small Reynolds numbers are treated. (TSS) (Diss. Abstr. Int., B)

27151 RESPONSE OF SPHERICAL AND CYLINDRICAL ELECTROSTATIC PROBES IN A LOW-DENSITY COLLISIONLESS PLASMA. Shaeffer, John Fredrick. St. Louis; St. Louis Univ. (1971). 138p. University Microfilms Order No. 72-5325.

Thesis.

The response of spherical and cylindrical electrostatic probes in a low-density collisionless plasma was measured and compared to the theoretical behavior as calculated by Laframboise. The experimentally measured values of the nondimensional normalized electron and ion saturation currents, I_e and I_i respectively, were examined as functions of: probe radius + Debye length R_p/λ_d; probe potential V_p normalized with respect to electron temperature eV_p/kT_e; and for an ion-to-electron temperature ratio $T_i/T_e < 0.1$. The spherical probe response for electron and ion saturation current essentially agrees with theory. R_p/λ_d was varied between 0.5 and 12.0 while normalized potential $|eV_p/kT_e|$ ranged between ±25. The cylindrical probe response did not completely agree with theory. An end effect, predicted by Hester and Sonin for a stationary plasma and observed in flowing plasmas, was measured. R_p/λ_d was varied between 4 and .05, which placed the probe for ion collection almost completely in the orbital motion limited (OML) regime, where theory predicts I_i to be independent of R_p/λ_d. Normalized potential $|eV_p/kT_e|$ ranged between ±25. Electron saturation current I_e agreed with theory for $R_p/\lambda_d > 1$, while for $R_p/\lambda_d < 1$, the agreement depends upon probe radius and length. Ion saturation current I_i is shown to be independent of R_p/λ_d in the OML regime as predicted; however, the absolute values of I_i, before and effects occur, are approximately 1.8 larger than predicted. End effects for ion saturation are shown dramatically. I_i becomes very large as R_p/λ_d becomes small. The plasma used for this study was produced by two oppositely oriented low-voltage arcs, each placed in a right angle tube to prevent primary electrons from reaching the experimental region. The plasma generators were electrically floating to insure no net charge production. The gas was xenon at 10^{-3} torr with $T_e \sim 2$ volts and N ranging from 10^7 to 10^{10} electrons/cm^3. (Diss. Abstr. Int., B)

27152 DEVELOPMENT OF NEW PLASMA DIAGNOSTIC TECHNIQUE USING SLOW POSITRONS. Lohnert, Guenter. Gainesville, Fla.; Univ. of Florida (1971). 146p. University Microfilms Order No. 72-9707.

Thesis.

Interactions of positrons with a plasma allow investigations of plasma parameters such as density, temperature, and velocity distribution of the electrons. Theoretical considerations show that, for the positron–plasma interactions, a beam of slow positrons has to be used in order to obtain detectable effects. Measurements of positron lifetime in the plasma and of the angular correlation of the annihilation radiation yield information on electron density and temperature. A parallel beam of slow positrons injected into a plasma will be spread into an angle $\langle\alpha\rangle$ after leaving the plasma due to the cumulative effect of small-angle scattering of the positrons with the microfield of the plasma. In measuring $\langle\alpha\rangle$, the microfield and hence the electron density can be found. A rigorous derivation of the average scattering angle of the positrons as a function of the electron density and gas pressure is developed. The theoretical results are applied to a special test plasma. A device was designed and constructed that is capable of producing a beam of slow positrons. Both ^{22}Na and ^{58}Co are possible commercially available positron sources. Employing a ^{22}Na source of 2 mCi, the device produces 1850 slow positrons per second, at a beam radius of 1.9 mm. In order to verify the theoretical expression for the beam spread and to demonstrate the feasibility of the new plasma diagnostic technique, a He plasma (14 cm diameter) was built. The slow positrons were injected into the plasma from a high-vacuum system into the plasma chamber through an ultrathin window (200 Å). Spectroscopic and probe measurements were carried out. The results compared well with the beamspread measurements. (Diss. Abstr. Int., B)

27153 PLASMA DIAGNOSTICS WITH ATOMIC BEAMS. Inoue, Nobuyuki (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 32: No. 4, 1095-1101(Apr 1972).

The ion density of a hydrogen plasma is determined from attenuation of the hydrogen atom beam mainly due to the resonant charge-exchange reaction between protons and hydrogen atoms. Then the measurable density is from 10^{13} to 10^{15} cm^{-3}. It is extended from 10^9 to 10^{15} cm^{-3} by using a potassium atom beam. The electron temperature from 20 to 150 eV is measured with an argon-atom beam. Some results by these methods are compared with those by other diagnostics. (auth)

27154 DETERMINATION OF THE ELECTRON DENSITY PROFILES AT THE ONSET OF IONIZATION RELAXATION IN A SHOCK-PRODUCED ARGON PLASMA. Larcher, Ghislain; Maillot, Patrice; Thenard, Claude (Univ. Rouen, Mont-Saint-Aignan, France). Compt. Rend., Ser. B; 274: No. 3, 167-70 (17 Jan 1972). (In French).

A microwave setup operating at 70.8 GHz used for electron density measurements (4×10^{12} to 4×10^{13} cm^{-3}) is described. The equipment was used to study the onset of ionization relaxation in a shock-produced plasma. The preliminary results obtained with Mach numbers of the order of 12 and a gas pressure of 1.5 torr, are presented. (France)

Kinetics (General)

27155 (AD–733337) CONTAINMENT PROBLEMS IN ELECTRICAL AND NUCLEAR PROPULSION. Final Report. Murthy, S. N. B. (Ohio State Univ. Research Foundation, Columbus). Aug 1971. Contract F33615-67-C-1758. 129p. (ARL–71-126). NTIS.

Containment is understood in the report as the process of confining a certain region of space from its adjoining regions with respect to the exchange of mass, momentum, and energy. The measures of containment applicable to technological devices are established and discussed. In the field of propulsion, the development of electrothermal and electromagnetic thrustors, gas core nuclear reactor thrustors and fusion thrustors is examined with respect to the containment problems involved therein. The major problems associated with any containment scheme are the incomplete interaction between the input mass flow and the applied fields, the occurrence of spurious losses and the setting of a variety of instabilities. In all of the thrustors under consideration, the possible use of a rotational velocity field (mechanically or electromagnetically induced) has lead to a variety of fluid-dynamical and MHD simulation experiments; they are discussed in some detail. The theoretical calculations that may be performed on containment are illustrated with a series of seven examples. One way of discussing the current status of containment problems is to examine the feasibility of scaling simple containment devices, and such a discussion is presented from several points of view. (auth) (NTIS)

27156 SCATTERING OF BEAM ELECTRONS IN A BEAM–PLASMA INTERACTION. Hawkins, Charles Edward. Hanover, N. H.; Dartmouth Coll. (1971). 211p. University Microfilms Order No. 72-8489.

Thesis.

The linear theory of the beam–plasma interaction is well established as providing an explanation of the means by which directed energy from a beam of charged particles is transferred to collective oscillatory motion of a plasma. The development of the interaction beyond the linear stage was studied experimentally. The relationship between the broadening of the beam electron distribution and the saturation of the unstable mode was explored. The experimental results were explained by means of a modified Brownian motion model. (TSS) (Diss. Abstr. Int., B)

27157 MAGNETOGASDYNAMIC HEAT TRANSFER TO A HEMISPHERICAL BODY IN A SUPERSONIC ARGON PLASMA. Nowak, Robert James. Evanston, Ill.; Northwestern Univ. (1971). 169p. University Microfilms Order No. 72-7828.

Thesis.

The influence of an applied, internal magnetic field on the local, cold wall heat transfer to a hemispherical body in a supersonic argon plasma is reported. Both electrically conducting and nonconducting surfaces are studied. Diagnostic measurements define the low-density arcjet flow. In addition, freestream, shock layer, and wall electrical phenomena are explored. For the conducting surface, the local heat flux is considerably greater than for the

nonconducting surface—either with or without an applied magnetic field. Current fluxes through the conducting surface account for the differences in heat flux. (Current fluxes are induced by the nonuniform, shock layer plasma potential.) Stagnation point heat flux for the conducting surface is increased 200% by a 9600-G dipole-like magnetic field. At higher body angles the local heat flux is reduced by the field. Measured Hall currents are shown to significantly influence the heat transfer. Magnetic field effects on the heat transfer for the nonconducting surface are similar but considerably less. Agreement between the measured local heat flux without magnetic field and convective laminar heat transfer theory is good for the nonconducting surface. With an applied magnetic field, comparison with existing magnetogasdynamic theory is not possible since all theories (known to the author) predicted a net reduction in stagnation point heat flux. This aspect is discussed. Radiation heat transfer and Joule heating are shown to be negligible under the present experimental conditions. (Diss. Abstr. Int., B)

27158 APPLICATION OF RECOMBINATION PROCESSES TO THE SELECTIVE MODIFICATION OF POPULATIONS OF EXCITED STATES OF ATOMS AND IONS. I. Semenova, O. P. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 104-11(1971). (In Russian).

Recombination processes were studied for a plasma of average density. Conclusions were drawn regarding the relative possibility of employing ternary recombination processes for enhancing the populations of highly excited states of atoms and ions in a gas-discharge plasma, assuring the most abrupt change of these populations with a predominant population of a higher state. Supplementary recombination processes are indicated that, under certain conditions, should guarantee increased populations among the highly excited states of atoms and ions that possess displaced states—nonradiating two-part recombination and ternary recombination of ions formed by the removal of an electron from an inner shell. (tr-auth)

27159 CONFIGURATIONS AND MODES OF AN H-COMPRESSED DISCHARGE. Gorshkova, L. D.; Pavlovskii, A. I.; Podmoshenskii, I. V.; Savchenko, V. A. High Temp. (USSR) (Engl. Transl.); 9: No. 4, 762-4(Jul-Aug 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 4, 844-6(Jul-Aug 1971).

Several configurations of an H-compressed discharge are described. The classification of various possible geometrical forms and operating modes of the discharge are considered. (M.O.W.)

27160 APPARATUS FOR PRODUCING AN ION BEAM BY REMOVING ELECTRONS FROM A PLASMA. Eloy, Jean-Francois (to Commissariat a l'Energie Atomique). U. S. Patent 3,644,731. 22 Feb 1972. Priority date 15 May 1968, France.

A method is described for production of ions wherein a plasma is generated from a target and then subjected to a number of successive electric fields to sort the particles which form the plasma by providing the successive electric fields with increasing amplitudes to slow down the electrons, then collecting the electrons on electrodes and causing the ion-enriched beam to converge towards the exit aperture by means of a final electric field. (auth)

27161 THERMODYNAMIC PROPERTIES OF HYDROGEN-HELIUM PLASMAS. Nelson, H. F. (Univ. of Missouri, Rolla). J. Spacecraft Rockets; 9: No. 3, 177-81(Mar 1972).

The thermodynamic properties of an atomic hydrogen–helium plasma were calculated for postulated conditions present in a stagnation shock layer of a spacecraft entering the atmosphere of Jupiter. These properties can be used to evaluate transport properties, to calculate convective heating, and to investigate nonequilibrium behavior. The calculations were made for temperatures from 10,000 to 100,000°K, densities of 10^{-7} and 10^{-5} g/cm^3, and three plasma compositions: pure hydrogen, 50% hydrogen, 50% helium, and pure helium. The shock layer plasma consists of electrons, protons, atomic hydrogen, atomic helium, singly ionized helium, and doubly ionized helium. The thermodynamic properties which were investigated are: pressure, average molecular weight, internal energy, enthalpy, entropy, specific heat, and isentropic speed of sound. A consistent model was used for the reduction of the ionization potential in the calculation of the partition functions. (auth)

Kinetics (Experimental)

27162 (COO-3421-2) INVESTIGATION OF DOPPLER-SHIFTED H_β RADIATION EMITTED FROM AN ELECTROSTATICALLY-CONFINED, SPHERICALLY SYMMETRIC, HYDROGEN PLASMA. McKeon, Robert John (Pennsylvania State Univ., University Park. Dept. of Nuclear Engineering). Sep 1971. 57p. Dep. NTIS.

Thesis.

Spectroscopic observations through the center of an electrostatically-confined, spherical, hydrogen plasma are reported. These observations indicate the presence of a wing structure about the H_β line, i.e., $\lambda = 4861.3$ Å. The wing structure follows a $[\Delta\lambda^2_{max} - \Delta\lambda^2]^{-\frac{1}{2}}$ behavior for $|\Delta\lambda| < 0.7\ \Delta\lambda_{max}$, where $\Delta\lambda$ is the wavelength shift from the undisturbed H_β line, and $\Delta\lambda_{max}$ is the maximum Doppler shift consistent with the applied potential of the electrostatic confinement device. A theory which yields the above wavelength dependence is proposed. The theory assumes spherical symmetry, no space charge effects, and, the presence of fast, excited, hydrogen atoms resulting from charge exchange or dissociation collisions between H_2^+ ions and background neutrals. A comparison of the values of $\Delta\lambda_{max}$ determined from the experimental data and calculated using the Doppler formula indicates good agreement. The observed wing structure exhibits an unpredicted asymmetry, as yet unexplained, about the undisturbed H_β line. (auth)

27163 (LBL-577) LOW-FREQUENCY WAVES, STABILIZATION, AND ENHANCED TRANSPORT IN THE PLASMA SURROUNDING A HOLLOW CATHODE DISCHARGE. Wheeler, George MacGregor (California Univ., Berkeley. Lawrence Berkeley Lab.). 6 Jan 1972. Contract W-7405-eng-48. 224p. Dep. NTIS.

Thesis.

Low-frequency waves, particle transport, and stabilization are studied in the secondary plasma of a hollow-cathode arc discharge. Plasma is transported across and along an axial magnetic field of 580 to 1160 gauss by diffusion in a partially ionized plasma, by mobility in the radial electric field, and by wave-enhanced convection. Experimental studies were made for each. (M.O.W.)

27164 RELAXATION PROCESSES IN A JET OF LOW-TEMPERATURE ARGON PLASMA WITH ADMIXTURE OF CO_2. Alieva, I. A.; Yushchenkova, N. I. (Inst. of Chemical Physics, Moscow). Izv. Akad. Nauk. Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk; No. 6, 121-5(1970). (In Russian).

The effect of CO_2 on the relaxation of the electron temperature and concentration distribution of electrons in an ultrasonic expanding jet of low-temperature argon plasma was investigated for $T_{e0} = 6{,}000$ to 8,000°K. The elemental processes occurring between Ar, CO, CO_2, O, and O_2 are discussed. The temperature distribution along the jet axis under various conditions is evaluated. (K.S.W.)

27165 ION PRODUCTION IN ARGON ION ENGINE DISCHARGES. Martin, A. R. (City Univ., London). Physica; 58: No. 1, 77-87(1 Mar 1972).

The ion production probabilities in an argon discharge plasma are studied under various conditions. The plasma consists of a group of high-energy primary electrons and one of low-energy Maxwell electrons. The radial behavior of the probabilities is discussed for the unperturbed discharge and for the case where an ion beam is being extracted. Topographical mappings are constructed for the probabilities, again in the perturbed and unperturbed cases. The results show that the primary electrons ionize most of the gas atoms in the discharge, although the Maxwell electrons have about ten times the number density. Also, the extraction of an ion beam does not have much effect upon the ionization properties of the discharge plasma. (auth)

27166 FORMATION OF MOLECULAR HELIUM IONS BY ASSOCIATIVE IONIZATION IN A RECOMBINING PLASMA. Robben, F. (Univ. of California, Berkeley). Phys. Rev., A; 5: No. 3, 1516-22(Mar 1972).

The afterglow of a 1.3-A, 1.5-μsec-duration discharge in helium at 11 torr was studied during the time 15 to 35 μsec after the discharge pulse. A 10-μsec current pulse was used to selectively heat the electrons, and it was found that the differences in the atomic and molecular intensities subsequent to this heating pulse could be explained by assuming a process of associative ionization of excited atomic helium states resulting in molecular helium ions, $He^{**} + He \rightarrow He_2^+ + e^-$. The rate of this process is determined. It is further shown, by comparison of excited-atomic-state densities with previous measurements at much lower pressures, that there must be a source, rather than a loss, of lower-lying atomic states. A model is proposed in which associative ionization of highly excited atomic states results in vibrationally and rotationally excited molecular ions, which subsequently relax by

neutral helium collisions to the ground-state level. Dissociative recombination of these excited molecular ions while in the process of going to the ground-state level then forms a source of additional lower excited atomic states. Extremely rapid vibrational and rotational relaxation rates are required. (auth)

27167 RECOMBINATION AND IONIZATION IN A MOLECULAR-ION-DOMINATED HELIUM AFTERGLOW. Johnson, A. Wayne; Gerardo, J. B. (Sandia Labs., Albuquerque, N. Mex.). Phys. Rev., A; 5: No. 3, 1410-18(Mar 1972).

An intense source of free electrons was observed to strongly influence the time history of the electron density in a high-pressure (>15-torr) helium afterglow. The electronic recombination coefficient α of molecular helium ions was measured by utilizing this source and was found to be over five times larger than the effective recombination coefficient obtained by equating the net loss rate of free electrons to the recombination loss rate in the usual manner. If α is assumed to be of the form $\alpha = \alpha_0 + k_p p$, then $\alpha_0 = 1.1 \times 10^{-8}$ cm^3 sec^{-1} and $k_p = 4.1 \times 10^{-10}$ cm^3 sec^{-1} torr^{-1} over the pressure range from 15 to 56 torr. A model is presented which indicates that ionizing metastable–metastable collisions are responsible for the source of free electrons. (auth)

27168 NUMERICAL INVESTIGATION OF THE WEAK-BEAM PLASMA. Burns, Thomas Benedict. Iowa City, Iowa; Univ. of Iowa (1971). 174p. University Microfilms Order No. 72-8222. Thesis.

A study was made of the one-dimensional weak-beam electron plasma with discrete electrostatic modes. An analytic review of the quasi-linear theory is given, and relationships between the macroscopic quantities for the plasma are predicted. Numerical simulation of the plasma is made, using the time-dependent coefficients of a power transform of the Vlasov–Poisson system of equations. The initial conditions chosen to represent the weak-beam plasma are closely related to the combination of two Maxwellians. These conditions result in more than one wave component per mode initially. The behavior of the waves in multiwave systems was also studied, and the electrostatic energy spectra and total electrostatic energy variations were obtained. The quasi-linear predictions for some macroscopic quantities were also verified even in the presence of damped waves. (Diss. Abstr. Int., B)

27169 ELECTRON ENERGY SPECTRUM IN A STRATIFIED GLOW DISCHARGE IN HYDROGEN. Kagan, Yu. M.; Mitrofanov, N. K. (Leningrad State Univ.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 10, 1636-41(Apr 1972).

Translated from Zh. Tekh. Fiz.; 41: No. 10, 2065-72(Oct 1971).

The measurement of the electron energy distribution along striations in a positive discharge in hydrogen is described for different currents and pressures. (auth)

27170 STUDY OF THE PROFILE OF THE $\lambda = 5876$ A He LINE IN THE AFTERGLOW EMISSION. Cheval, G.; Fabre, G.; Farges, M. F.; Stringat, R. (Univ., Nice). Compt. Rend., Ser. B; 274: No. 1, 31-4(3 Jan 1972). (In French).

The shape of the 5876-Å He line of an afterglow emission was studied using a Fabry–Perot spectrometer. The method employed to determine the characteristics of the instruments is described. The profile of the line recorded was compared with a profile calculated from the instrument characteristics and a Gaussian function corresponding to the Doppler effect at 300°K. The comparison also demonstrated another cause for the broadening: populating of the 3^3D level by dissociative recombination. (France)

27171 PECULIARITIES OF THE BEHAVIOR OF THE ELECTRIC CONDUCTIVITY AND RADIATION FROM A DENSE HIGH-TEMPERATURE PLASMA. Batenin, V. M.; Minaev, P. V. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 9: No. 4, 619-24(Jul-Aug 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 4, 676-82(Jul-Aug 1971).

Measurements of the electric conductivity and the optical reduction of the ionization potential were carried out in a high-pressure argon or mercury arc plasma. A correlation of the peculiarities of the behavior of the electric conductivity and the radiation was observed. The deviation from calculations obtained from the formulas for a rarefied plasma was observed for $\ln \Lambda \sim 4$, the quantity $\Delta E_{opt}/kT$ reaching unity under these conditions. (auth)

27172 EXPERIMENTAL INVESTIGATION OF COULOMB INTERACTION IN A DENSE PLASMA. Ermokhin, N. V.; Kovalev, B. M.; Kulik, P. P.; Ryabyi, V. A. (Moscow Aviation Inst.). High Temp. (USSR) (Engl. Transl.); 9: No. 4, 611-18(Jul-Aug 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 4, 665-75 (Jul-Aug 1971).

The nature of Coulomb interactions in a plasma was examined under conditions where the number of charged particles in a sphere of Debye Radius $\zeta \sim 1$. Measurements were made of the specific electrical resistance of a spatially homogeneous, stationary cesium plasma with $T \cong 3000$°K and $p = 10^{-2}$ to 1 atm. Experimental information was obtained on the diffusion cross section for electrons and cesium atoms; this allowed one to separate the Coulomb interaction part in the measured values of specific resistance. It was found that, in the region $\zeta = 1$ to 10, the experimental value of the Coulomb component of the specific resistance of the plasma increases systematically in agreement with current asymptotic theory. Analysis of the experimental data obtained allows one to conclude that, for the description of Coulomb interaction in a dense plasma under the given conditions, it is reasonable to use the notion of effective "pairs" of Coulomb cross sections with the screened Coulomb field of charged particles at a distance of the order of the inter-ion distance. (auth)

27173 MEASUREMENT OF ELECTRON ENERGY DISTRIBUTION FUNCTIONS IN NONSTATIONARY PLASMAS BY A SAMPLE AND HOLD TECHNIQUE. Saggau, B. (Univ., Stuttgart). Z. Angew. Phys.; 32: No. 5-6, 324-8(1972). (In German).

A practicable method is described for measuring the 2nd derivative of a Langmuir probe characteristic for determining the electron energy distribution function in a nonstationary plasma. By using a sample and hold technique, a temporal serial measurement of three working points of a probe characteristic is transformed to a parallel one. The 2nd derivative is won by forming the double difference of these three parallel values. The method is demonstrated by measurements in standing and moving striations in argon. (auth)

27174 STATE OF POPULATION INVERSION IN AN ELECTROMAGNETIC SHOCK TUBE. Byszewski, W. W.; Dembinski, M. (Inst. of Fundamental Technical Problems, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 19: No. 11-12, 857-62(1971).

Results of research on the possibilities of achieving the inversion of population state in plasma behind a shock wave are presented. The investigations were made in a symmetric electrodeless shock tube generating colliding shock waves. Population inversion at Ar II ionic levels $4p^2\,D_{\frac{1}{2}}$ and $4s^2\,P_{\frac{1}{2}}$ (line 4880 Å) were observed for a 3.75-μF capacitor bank at a 25 kV. The inversion was observed in a narrow range of initial pressures 0.06 to 0.2 torr. The investigations were carried out by measuring the attenuation of the light beam crossing the shock tube. (auth)

Kinetics (Theoretical)

27175 (N-72-12734) SINGULAR PERTURBATION METHODS AND THE WARM-PLASMA MODEL. Lee, S. W.; Deschamps, G. A. (Illinois Univ., Urbana. Antenna Lab.). Aug 1971. 58p. (NASA-CR-124623; SR-18; UILU-ENG-71-2546). NTIS.

The application of techniques of the singular perturbation theory to the analysis of warm plasma is discussed. The cold plasma model can be applied over wide ranges of parameters, but only over narrow ranges forming so-called boundary layers is the warm plasma model used. Simplified equations can be used and the solutions matched on both sides of the layer's boundary. Simple examples to illustrate the solution are presented. The analysis confirms that some results are highly sensitive to the values of: (1) wire radius or gap size for an antenna, (2) temperature of the medium, and (3) incident angle of a plane wave. (auth) (STAR)

27176 (TRITA-EPP-72-1) PARTIALLY IONIZED PLASMA CENTRIFUGE. Lehnert, B. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). 2 Jan 1972. 18p. Dep. NTIS (U. S. Sales Only).

The partially ionized plasma centrifuge contains a neutral gas mixture of isotopes or elements, the motion of which is driven by a small amount of rotating plasma. The plasma motion is, in its turn, controlled by externally imposed electric and magnetic fields. Earlier investigations of the centrifuge are extended by an analysis of its operation conditions. It is shown that high rotational velocities, large separation degrees, and stable velocity profiles can be achieved at comparatively small power losses, within certain ranges of the parameters involved. (auth) (Sweden)

27177 EQUILIBRIUM DISTRIBUTION OF TEMPERATURE AND PRESSURE IN A STATIONARY DISCHARGE WITH EMISSION. Alikhanov, S. G.; Konkashbaev, I. K. Zh. Prikl. Mekh. Tekh. Fiz.; No. 4, 133-5(Jul-Aug 1971). (In Russian).

Results of numerical calculations are given for the energy and

momentum balance for a stationary discharge in a dense plasma. The equilibrium in a cylindrical section of plasma without a longitudinal magnetic field is considered, when the pressure of the plasma is confined by a magnetic field of an internal current flowing along the z axis. The solutions to the problem serve to illustrate the different types of equilibrium distribution of temperature and pressure for high-density discharges. (K.S.W.)

27178 RESONANCE STATES OF THE TOTAL CHARGE DENSITY FOR A RELATIVISTIC PLASMA. Lupu, G. (Univ., Cluj). Lett. Nuovo Cim.; 3: No. 8, 329-31(19 Feb 1972).

An integral equation for the total charge density for a relativistic plasma is given. Resonance states due to nonlinear interactions in the system are investigated. The integral equation is investigated in the time interval when the effect of instability in the relativistic plasma becomes dominant. (M.O.W.)

27179 INTENSITY-DEPENDENT PROPAGATION CHARACTERISTICS OF CIRCULARLY POLARIZED HIGH-POWER LASER RADIATION IN A DENSE ELECTRON PLASMA. Steiger, Arno D.; Woods, Cornelius H. (Univ. of California, Livermore). Phys. Rev., A; 5: No. 3, 1467-74(Mar 1972).

Circularly polarized laser radiation propagating in an electron plasma drives the electrons into circular orbits. This orbital motion induces a magnetic field which is either parallel or antiparallel to the laser beam. The generation of this magnetic field is known as the inverse Faraday effect. Because of this magnetic field and the relativistic change of the electron mass, the wave propagation is enhanced for high intensities in the sense that the critical plasma density increases with the laser-beam intensity. For the wavelength $\lambda = 1.06\ \mu$, corresponding to a neodymium-glass laser, the dependence of the various propagation characteristics on the brightness of the beam is examined in detail. Electron densities varying between 10^{20} and 6.6×10^{24} particles per cm^3 and radiation intensities in the range 10^{17} to 10^{20} W/cm^2 are considered. Energy losses caused by synchrotron radiation and by electron–ion bremsstrahlung are calculated. (auth)

27180 TWO-QUANTUM PROCESS IN A LABORATORY PLASMA. Palumbo, Louis John. Washington, D. C.; Georgetown Univ. (1971). 187p. University Microfilms Order No. 72-10,399.

Thesis.

A prominent peak in the soft x-ray continuous emission from a laboratory plasma has been associated with a two-quantum process in highly ionized neon. A measurement of the time-integrated absolute intensity of this continuum feature, when compared with plasma conditions derived from the measured time-integrated absolute intensity of the Ne IX $1s2p\ ^3P - 1s^2\ ^1S$ intercombination line, shows that the observed continuum feature is too strong (by about two orders of magnitude) to be explained by spontaneous two-photon emission of the $1s\ 2s\ ^1S$ state of Ne IX. However, the shape of the continuum feature indicates that it is probably due to some type of two-quantum process such as radiative Auger emission in Ne VIII, and the intensity of the feature indicates that the upper level is excited by dielectronic capture onto ground-state Ne IX. The absolute intensities of the continuum and of the line radiation were measured by performing an absolute-intensity calibration on a grazing-incidence spectrograph. The calibration method is described, as are various plasma-diagnostic methods used to obtain plasma conditions needed for calculating the intensity of line and continuum radiation expected from the plasma. (Diss. Abstr. Int., B)

27181 LINEAR TRANSIENT RESPONSE OF A PLASMA TO A PULSED ELECTRIC FIELD. Sodha, Mahendra Singh (Drexel Univ., Philadelphia); Ghatak, Ajoy Kumar. J. Appl. Phys.; 43: No. 4, 1529-31(Apr 1972).

A transient solution was obtained for Boltzmann's transfer equation for electrons in a plasma, subjected to a weak pulsed electric field, and this solution was used to derive an expression for the transient current density. Explicit expressions for the current density and energy absorbed (during the pulse) have been given when (i) the pulsed field is dc or sinusoidal in nature and (ii) the electron collision frequency is proportional to v^s ($s = 0, 1, 2$) (v being the electron velocity). It is seen that the nature of velocity dependence of collision frequency (viz., the value of s) has little effect on the attainment of steady state. The present theory (i) neglects the collective plasma phenomena, which is valid when the frequency of the field is appreciably different from the plasma frequency, (ii) ignores electron–ion and electron–electron collisions, which is valid for weakly ionized plasmas, (iii) ignores nonlinear effects, and (iv) neglects the effects of ion motion (which is appreciable only for highly ionized plasmas and very low frequencies of the field). (auth)

27182 APPLICATION OF AN EFFECTIVE-POTENTIAL METHOD TO A TWO-COMPONENT PLASMA. Sanborn, James Vernon. Davis, Calif.; Univ. of California (1971). 166p. University Microfilms Order No. 72-9913.

Thesis.

The statistical mechanics of a totally neutral plasma, consisting of positive ions and negative electrons, is investigated. The method used is referred to as the effective-potential method. It consists of replacing very complicated "sum over states" expressions for the quantum density matrix by a quasi-classical Boltzmann-like factor with a pairwise additive effective potential of interaction. Once the effective potentials are obtained, thermodynamic averages can be determined by "classical" methods for performing many dimensional integrations over Boltzmann-like expressions. Collective coordinates are used to evaluate the integrals, in which the effective potentials mock up both the effects of quantum diffraction and quantum statistics. The zero-temperature, high-density or degenerate limit and the high-temperature, low-density or "classical" limit are studied. Expressions for the energy are compared with existing perturbation results. In the degenerate limit, the results are equivalent to assuming a Jastrow-type wave function for the ground state of electrons, and therefore the effective potential method can be thought of as a statistical mechanical generalization of the concept of a Jastrow-type ground state wave function for nonzero temperature. (Diss. Abstr. Int., B)

27183 DIFFUSION COOLING OF ELECTRONS IN AFTERGLOW PLASMAS. Bhattacharya, A. K.; Ingold, J. H. (General Electric Co., Cleveland). J. Appl. Phys.; 43: No. 4, 1535-42 (Apr 1972).

The results of mass-identified measurements of the decay of positive atomic ion number densities in low-pressure rare-gas afterglow plasmas are reported. At high gas pressure, the loss of atomic ions is due to conversion into molecular ions and by ambipolar diffusion to the wall of the container. At low pressures, the loss of atomic ions is only by diffusion to the wall but at a slower rate than that of ambipolar diffusion; this slow loss rate is interpreted as a manifestation of electron diffusion cooling in heavy rare gases. A semiquantitative theoretical explanation of diffusion cooling is offered and shown to be in good agreement with the results of measurements of electron decay rates in Ne and Ar afterglows and of ion decay rates in Ne afterglows. Comparison with ion decay measurements in Ar, Kr, and Xe are also given. (auth)

27184 QUANTUM KINETIC EQUATIONS FOR ELECTRONS IN RANDOM SCATTERING CENTERS. Fisher, David Michael. Columbia, Mo.; Univ. of Missouri (1971). 80p. University Microfilms Order No. 72-10,595.

Thesis.

For systems consisting of electrons interacting with scattering centers and arbitrary electromagnetic fields, a method is developed by which the quantum kinetic equation for the average one-electron density matrix can be derived to any desired order in an electron-field interaction and to all orders in an electron-scatterer interaction. The steady-state solutions are given. The steady-state solution of the linear average density matrix is used to develop the power absorbed by a weakly ionized plasma. A realistic electron–neutral atom interaction is used; in an approximation in which the neutral atoms do not change states, results similar to those arrived at using central potential approximations are derived. A second method of getting a kinetic equation is shown. Using a systematic averaging technique, a quantum kinetic equation is derived and an alternate method to the Legendre polynomial expansion of the distribution function is used to derive the collisional damping decrement for self-consistent oscillations. (Diss. Abstr. Int., B)

27185 AVERAGE FORCES ON A MAGNETIZED PLASMA IN A HIGH-FREQUENCY FIELD. Rukhadze, A. A.; Sever'yanov, V. V. (Tula Pedagogic Inst., USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 10, 1608-11(Apr 1972).

Translated from Zh. Tekh. Fiz.; 41: No. 10, 2029-34(Oct 1971).

The behavior of a plane magnetized-plasma layer in the field of an electromagnetic wave that propagates along the layer is considered. The resonance frequencies and the average forces exerted on the electrons and ions are determined. At low frequencies electrons far from the boundary are repelled from the regions of greatest electric field if the ion-acoustic velocity is greater than the Alfvén velocity; if the Alfvén velocity is greater than the ion-acoustic velocity the electrons are attracted. (auth)

27186 HOMOGENEOUS POSITIVE COLUMN IN HELIUM AT MODERATE PRESSURES. Kagan, Yu. M.; Lyagushchenko,

R. I.; Khristov, N. (Leningrad State Univ.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 10, 1627-35(Apr 1972).

Translated from Zh. Tekh. Fiz.; 41: No. 10, 2053-64(Oct 1971).

The "intensive" parameters of a positive column in helium (longitudinal field E, electron temperature T_e, and electron density u_e) are considered as functions of the "extensive" parameters (discharge current i, gas pressure p, and tube radius R). The deviation of the fast-electron distribution function from a Maxwellian and the stepwise character of ionization are taken into account. A scaling law is established. (auth)

27187 ENERGY LOSS OF A RELATIVISTIC ION IN A PLASMA. Gould, R. J. (Univ. of California, San Diego, La Jolla). Physica; 58: No. 3, 379-83(1 Apr 1972).

The stopping power of a plasma for a relativistic heavy ion is calculated in a simplified derivation. The total contribution results from (a) individual electron scattering in the Coulomb field of the ion wherein large momentum transfers are involved and (b) small momentum transfers in which quantized plasma oscillations are excited. The resulting general formula for the stopping power is in agreement with a specialization of the results of a more elaborate treatment by Tsytovich. The nonrelativistic limit of the general formula agrees with an expression given earlier by Larkin from field-theory techniques and by the author in a Born-approximation approach. However, the general formula differs slightly in its details from that given by Hayakawa and Kitao. (auth)

27188 CUMULATION OF PLASMA AND MAGNETIC FIELD AS A RESULT OF IMPLOSION OF A HEAVY CONDUCTING LINER. Kaliski, S. (Inst. of Fundamental Technical Problems, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 20: No. 1, 49-56(1972).

The combined cumulation problem of plasma and magnetic field by means of shooting a heavy conducting liner into the plasma is studied, using the averaged description. The plane and cylindrical problems are considered, a simple closed expression being obtained for the parameters of compression. The known solutions were obtained in particular cases of cumulation of the magnetic field alone or plasma alone. The limiting solutions for the plasma with no additional sources producing pressure (laser, magnetic field, mechanical pressure, etc.) have, in the averaged description, no physical sense. Within their validity limits, the solutions obtained are useful despite their approximate qualitative character, owing to a possibility of appraisal of the order of magnitude of the cumulation effects. (auth)

Production

27189 (IPP-IV-23) PRODUCTION OF HOT PLASMAS OF SOLID STATE DENSITY BY ULTRASHORT LASER PULSES. Salzmann, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Dec 1971. 49p. (In German). Dep. NTIS (U. S. Sales Only).

Ultrashort laser pulses emitted by a neodymium glass laser system were focused on the surface of solid targets situated in a high-vacuum environment. The laser pulse duration as measured by the TPF technique was less than 10^{-11} sec. Pulse energies up to 3 J were obtained, corresponding to a maximum energy release of 3×10^4 J cm^{-2} in the focal area. The plasmas produced from targets of solid deuterium, carbon, and thin foils of Mylar were investigated by x-ray measurements, TOF measurements using charge collecting probes and, in the case of deuterium, by neutron counters. Only 10% of the incident light energy was found to be reflected from the targets. Electron temperatures of 500 and 200 eV were measured for deuterium and carbon plasmas, respectively. The experimental results are found to be consistent with the predictions of the model of a thermal wave penetrating into the solid. (auth)

27190 ARGON PLASMAS PRODUCED IN SHOCK TUBES FOR SHOCK WAVE VELOCITIES BETWEEN MACH 10 AND MACH 13. Larcher, Ghislain; Maillot, Patrice; Thenard, Claude (Rouen Univ., Mont-Saint Aignan, France). Compt. Rend., Ser. B; 274: No. 1, 35-8(3 Jan 1972). (In French).

The results obtained by stroboscopic studies of striations on the observation time and the ionization relaxation times of an argon plasma obtained in a shock tube are presented for shock wave velocities between Mach 10 and Mach 13 in a gas with an initial pressure P_1 = 1.5 torr. (France)

27191 MAGNETIC-FIELD-DEPENDENT BREAKDOWN OF CO_2-LASER-PRODUCED PLASMA. Cohn, D. R.; Chase, C. E.; Halverson, W.; Lax, B. (Massachusetts Inst. of Tech., Cambridge). Appl. Phys. Lett.; 20: No. 6, 225-7(15 Mar 1972).

The threshold pressure for breakdown of helium and argon gas by 10.6-μm radiation from a TEA CO_2 laser is strongly depressed by a steady magnetic field parallel to the direction of propagation of the laser beam. At 87 kOe, the zero-field threshold pressure is reduced from 166 to 96 torr in helium and from 66 to 21 torr in argon. This result can be explained semiquantitatively by a simple model of breakdown that takes into account the inhibition of radial electron diffusion by the magnetic field. (auth)

Stability

Refer also to abstract 27244.

27192 (AD-733441) ELECTROMAGNETIC AND FINITE ELECTRON BETA EFFECTS ON THE MODIFIED TWO-STREAM INSTABILITY. McBride, John B.; Ott, Edward (Naval Research Lab., Washington, D. C.). Oct 1971. 15p. (NRL-MR-2366). NTIS.

When there is relative motion between electrons and ions across a magnetic field in a plasma, it has been shown theoretically that a modified two-stream instability may develop. This instability has a fluid-like character and can interact strongly with the ions. Also, it is insensitive to the electron–ion temperature ratio. Previous analyses have been restricted to the electrostatic limit. Electromagnetic and finite electron beta effects on this instability are considered. These effects are found to stabilize the instability in certain regions of the parameter space characterizing the plasma. Marginal stability curves are presented. Perhaps the most important result is that, for waves that are likely to produce large ion heating, instability occurs provided $U/N_A \leq (1 + \beta_e)^{1/2}$, where U is the relative drift speed and V_A is the Alfven speed. The experimental significance of the results is discussed. (auth) (NTIS)

27193 (AD-733742) HYDROMAGNETIC WAVE–PARTICLE BEAM INTERACTIONS. Final Report, December 1, 1969–August 31, 1970. Boley, Forrest I. (Dartmouth Coll., Hanover, N. H. Dept. of Physics). 14 Sep 1970. Contract F44620-70-C-0022. 4p. (AFOSR-70-2454-TR). NTIS.

Two investigations are described. The first concerns the interaction of an electron beam with the plasma formed by its interaction with a neutral gas; beam loss and plasma column instabilities were studied. The second concerns transport properties in a plasma column subject to drift-wave instabilities. A list of publications resulting from this research is provided. (auth) (NTIS)

27194 (AD-733976) THEORY AND SIMULATION OF THE BEAM CYCLOTRON INSTABILITY. Lampe, M.; Manheimer, W. M.; McBride, J. B.; Orens, J. H.; Papadopoulos, K. (Naval Research Lab., Washington, D. C.). Nov 1971. 69p. (NRL-MR-2358). NTIS.

A detailed theory in conjunction with the results of computer simulation experiments is presented for the beam cyclotron instability. The main results of the study are as follows: after a period of exponential quasi-linear development, turbulent wave–particle interactions become strong enough to cause cross-field diffusion of the electrons which smears out the electron gyroresonances; this level of turbulence results in a transition to ordinary ion sound modes that would occur in an unmagnetized plasma; the magnetic field serves to reduce the effects of electron trapping; this level of turbulence appears to have virtually no effect on long wavelength fluid modes; at this level the instability stabilizes if ordinary ion sound is stable due to ion Landau damping; for cold ions it continues to develop at the slower ion acoustic growth rate until the fields become strong enough to trap the ions; after the fields saturate, plasma heating is observed to continue; this heating is much slower than exponential. (auth) (NTIS)

27195 (AD-734128) TURBULENT HEATING IN COMPUTER SIMULATIONS OF THE MODIFIED PLASMA TWO-STREAM INSTABILITY. Ott, Edward; McBride, John B.; Orens, Joseph H.; Boris, Jay P. (Naval Research Lab., Washington, D. C.). Nov 1971. 15p. (NRL-MR-2365). NTIS.

Computer simulations of the fluid-like modified two-stream instability, driven by relative electron–ion drifts across a magnetic field, show strong anomalous plasma heating. The electron and ion heating rates are comparable and result in ion thermal speeds that approach the relative speed within a few ion plasma periods. (auth) (NTIS)

27196 (FRNC-TH-159) IONIC INSTABILITY IN THE PLASMA OF A POSITIVE COLUMN AT LOW PRESSURE SUBJECTED TO A RESONANT MICROWAVE FIELD. Pointu, Anne-Marie (Paris Univ., Orsay (France). Faculte des Sciences). 1970. 134p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The plasma of the positive column of a discharge tube may be the source of low-frequency oscillations when subjected to electromagnetic waves of suitable frequency, the f_1 frequency coinciding with one of the hf electrostatic resonances of the column. A model based upon a purely linear mechanism is used in the interpretation. The hf field is assumed to be initially modulated in amplitude by a frequency f (small in comparison with the electron plasma frequency). Such conditions produce a modulation at a frequency f in the surface charge density and the hf mode resonant frequency, and thus in the amplitude of the hf field of the plasma. This modulation is in phase with the initial modulation (positive reaction) for a series of discrete f values, $((f_3)n)$, which constitute the resonant frequencies. The existence of n = 0, 1, and 2 oscillations was verified experimentally. Such oscillations originate from a positive reaction phenomenon. A series of frequency values corresponding to successive resonance conditions (positive reaction) and antiresonance (negative reaction) was established for a plasma and a given hf power. (France)

27197 (UARAEE-119) ON THE INSTABILITY OF Θ-PINCH PLASMA WITH AZIMUTHAL MAGNETIC FIELD. El-Khalafawy, T. A.; Youssef, A. M.; Diatlov, V. G. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Accelerators and Plasma Physics Research). 1971. 16p. Dep. NTIS (U. S. Sales Only).

The characteristic parameters of the experimental device are: axial magnetic field H_z = 15 kG, discharge period T = 29 μs, axial rod current $I_z = 5 \times 10^4$ A, and plasma density n = 10^{13} to 10^{14} cm^{-3}. The H_r, H_φ, H_0 magnetic field components were measured by magnetic probes as spatial and temporal functions. The results give evidence of the existence of the toroidal magnetic surfaces during about 5 μs. The system major radius is approximately 3 cm, the minor one 2 cm. Using the magnetic measurement results, the topography of the azimuthal plasma current was calculated. The results prove large-scale MHD instabilities when the Kruskal-Shafranov criterion is not satisfied. The stabilization is possible if the azimuthal magnetic field increases. The electron current velocity was estimated, deduced from the plasma density and plasma current density; it turned out to be of the order of the thermal electron velocity. This makes possible the appearance of hydrodynamic current instability. The magnetic and electrical probe measurements show considerable plasma noise with a characteristic frequency of the order of tens of MHz. The turbulence may lead to the skin-layer destruction and, hence, to the destruction of the closed magnetic configurations. Thus, the plasma turbulence due to beam-plasma instabilities stands as the main reason of short lifetime of plasma. (auth)

27198 STREAMING INSTABILITIES IN RELATIVISTIC MAGNETOPLASMAS. Buti, B. (Physical Research Lab., Ahmedabad, India). Phys. Rev., A; 5: No. 3, 1558-63(Mar 1972).

Stability of superluminous and subluminous waves propagating transverse to the direction of the external uniform magnetic field is investigated in streaming relativistic homogeneous plasmas. In the relativistic regime for $\Omega < ck$ (Ω being the electron cyclotron frequency and k the characteristic wave number), the superluminous waves remain stable as in the absence of an external magnetic field; however, for the subluminous waves, the magnetic field has a tendency towards destabilization. For $\Omega \gg ck$, the superluminous waves are dynamically unstable for all streaming velocities U, which are smaller than U_c, or for magnetic fields Ω, which are greater than Ω_c, but for the waves with frequencies $\omega \ll \Omega (\Omega \gg ck)$, there exists a minimum streaming velocity above which the system is unstable. In the nonrelativistic regime the system is unstable if streaming is much larger than the thermal velocity, but otherwise stable. The unstable region is bounded by Ω_{min} and Ω_{max}, Ω_{min} being kv_t (v_t being the electron thermal velocity) and Ω_{max} being kU. (auth)

27199 ELECTROSTATIC CONTROL OF PLASMA MICROINSTABILITIES. Potter, Richard Mayes Jr. Wright-Patterson AFB, Ohio; Air Force Inst. of Tech. (1971). 117p. University Microfilms Order No. 72-10.

Thesis.

Optimal control theory is applied to the problem of controlling electrostatic microinstabilities in a homogeneous electron plasma. The electrostatic microinstabilities are described by a linear integro-differential system of equations, the linearized Vlasov equations. In the class of additive distributed controls, a time-varying electrostatic control produced by a control charge density is taken as a logical extension to the system equations. The region of control is considered fixed for a given problem. The linearized Vlasov system is reduced to a Volterra-like integral equation relating the perturbed number density and the control density to an initial disturbance. A quadratic criterion yields a Fredholm-like integral equation in the control density as a necessary and sufficient condition for optimality—the uncontrolled response serves as a driving term. An original generalized multiplier result yields an alternate "canonical" set of necessary equations. The necessary and sufficient equations are investigated for an isotropic and a two-stream electron plasma. The control region is taken to be all of configuration space so that spatial Fourier modes of the control density satisfy decoupled Fredholm integral equations in the time variable. The integral equations for the Fourier modes are reducible to linear two-point boundary-value problems, which are numerically solved. It is observed in both cases that there is good suppression of the Fourier modes of the perturbed density; interestingly, less control is required in the two-stream example. The physical significance of the examples studied appears limited. The limitations are discussed and suggestions are made for more physically interesting research. (Diss. Abstr. Int., B)

27200 LOW FREQUENCY FLUTE MODES IN FINITE-β PLASMAS. El-Nadi, Adel Mohamed. Madison, Wis.; Univ. of Wisconsin (1971). 87p. University Microfilms Order No. 72-410.

Thesis.

It is well-known that for a thermonuclear fusion reactor to operate efficiently, it has to confine a finite-β plasma (β is defined as the ratio of the plasma kinetic pressure to the magnetic field pressure). Under such conditions both the equilibrium and stability conditions are expected to be different from those in a zero-β plasma. A microscopic stability analysis is presented for the low-frequency flute modes ($k \cdot B = 0$) in a finite-β plasma confined in the magnetic field of a current carrying wire. All possible instabilities are studied for arbitrary density and temperature gradients. It is found that the plasma is stable against the interchange mode for any β if the plasma pressure increases away from the wire. If this condition is not met, the plasma will be always unstable even when a high-enough beta creates a minimum-B situation (∇B antiparallel to ∇P). The physical mechanism is the breakdown of the possibility of having a pure electrostatic mode in a finite-β plasma; the added transverse part is destabilizing and cancels the advantage gained from the more favorable drift conditions. It was also found that a plasma with a favorable pressure distribution exhibits a new instability in the high-β case, with the well-known condition for finite ion Larmor radius stabilization becoming the condition for the instability to exist. The stability condition for the temperature-gradient mode ($|T_\perp'/T_\perp| > |n'/n|$) is independent of beta. The fast flute mode is completely stabilized by finite-β over a wider range of temperature gradients; this arises from the increased gradient of B caused by diamagnetic currents. (Diss. Abstr. Int., B)

27201 NONLINEAR SATURATION OF THE COLLISIONAL TRAPPED-PARTICLE INSTABILITY. Jablon, C. J. (Princeton Univ., N. J.). Phys. Rev. Lett.; 28: No. 14, 880-2(3 Apr 1972).

The detrapping effects of fluctuating electrostatic potentials on trapped particles in a Tokamak geometry are investigated. It is shown that nonlinear detrapping saturates the collisional trapped-particle instability at a fluctuating potential φ such that $e\varphi \ll \epsilon T$, where ϵ is the inverse aspect ratio. (auth)

27202 SUPPRESSION OF THE FLUTE INSTABILITY IN A LOW-DENSITY PLASMA BY A FEEDBACK SYSTEM WITH A FINITE NUMBER OF ELEMENTS. Arsenin, V. V.; Dement'eva, T. G.; Kostomarov, D. P. Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 10, 1616-19(Apr 1972).

Translated from Zh. Tekh. Fiz.; 41: No. 10, 2040-4(Oct 1971).

A dispersion equation is derived for flute oscillations in a low-density magnetized plasma in the presence of a feedback system consisting of N sensors of the electric potential plasma boundary and N external electrodes whose potentials are controlled by signals from the sensors. A model based on an infinite cylinder with sharp boundaries in a radial gravitational field is used; the gravitational field simulates the effect of the curvature of the lines of force in a magnetic mirror. The dispersion equation is analyzed numerically for the case N = 1. A stability region is found in the plasma based on the density and the gain of the feedback system. Stabilization can be achieved at densities above the instability threshold for the $|m| = 1$ mode in the absence of feedback, but below the threshold for the second mode $|m| = 2$. The stabilization improves (i.e., the stability region widens) as the net unbalanced charge of the plasma increases. (auth)

27203 DRIFT-DIFFUSION INSTABILITY IN A WEAKLY IONIZED INHOMOGENEOUS PLASMA. Zhilinskii, A. P.; Tsendin, L. D. (Leningrad Polytechnic Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 10, 1620-3(Apr 1972).

Translated from Zh. Tekh. Fiz.; 41: No. 10, 2045-9(Oct 1971).

In a current-free, inhomogeneous, weakly ionized plasma in an external magnetic field, diffusion in the direction of the inhomogeneity can lead to low-frequency oscillations if the transverse ion mobility is greater than the electron mobility. The wave vector has three nonvanishing components. If $(\Omega\tau)_i < 1$, waves propagating in the direction of decreasing plasma density are unstable, but if $(\Omega\tau)_i > 1$, waves propagating in the opposite direction are unstable. The dispersion relations and growth rates are obtained for the two cases. (auth)

27204 INHOMOGENEITY SCALE OF IONIZATION INSTABILITY IN A PLASMA. Shipuk, I. Ya. (Inst. of Atomic Energy, Moscow). High Temp. (USSR) (Engl. Transl.); 9: No. 4, 757-8 (Jul-Aug 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 4, 839-40(Jul-Aug 1971).

It is assumed that, in the unperturbed state, the energy loss by electrons due to heat conduction is negligibly small in comparison with elastic loss and the entire temperature gradient is concentrated in a narrow layer near the walls. Under these conditions, the electron density and temperature are related by the Saha equation. The inhomogeneity scale of ionization instability is estimated from these considerations. (M.O.W.)

27205 NUMERICAL SIMULATION OF THE INSTABILITY OF AN IONIC BEAM. Alikhanov, S. G.; Musher, S. L. Zh. Prikl. Mekh. Tekh. Fiz.; No. 5, 165-8(Sep-Oct 1971). (In Russian).

The instability of an ionic beam in nonisothermal plasma is investigated, using as a model a particle in a cell. Ion-acoustic oscillations are thought to be established, and the oscillation energy is considered as lumped in adjacent modes, possessing maximum increment in linear theory. The subsequent process of instability development may be divided into three stages: exponential growth of energy of oscillations, a resonant harmonic stage and a fall-off of oscillations, and a disappearance of a regular pattern. (K.S.W.)

27206 STABILITY OF SHEARED ELECTRON FLOW. Rome, James A.; Briggs, Richard J. (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids; 15: No. 5, 796-804(May 1972).

The instabilities of a cylindrical electron stream driven by shear in the velocity parallel to the guiding magnetic field ($dv_{11}/dr \neq 0$) are analyzed. Quadratic forms are developed that bound the growth rates and provide necessary conditions for instability. An efficient numerical method for calculating the eigenfrequencies directly from the (singular) differential equation of a system with arbitrary velocity/density profiles is described. This numerical method is used to study the unstable modes of an unneutralized beam with velocity shear arising from space-charge potential depression. The computed growth lengths indicate that these modes are of practical importance in the propagation of high-perveance electron beams. (auth)

27207 THEORY AND COMPUTER EXPERIMENT ON SELF-TRAPPING INSTABILITY OF PLASMA CYCLOTRON WAVES. Hasegawa, Akira (Bell Telephone Labs., Murray Hill, N. J.). Phys. Fluids; 15: No. 5, 870-81(May 1972).

A theory explaining the self-trapping instability (modulational instability) of plasma cyclotron waves is developed, and the results are compared with computer experiments using a sheet current model. The observed growth rate at an initial phase of the instability is in rough agreement with that given by perturbation theory. However, as the level of the modulation increases, the rate of the growth of the modulation increases due to excitation of additional side bands, and finally, the carrier wave is found to collapse suddenly leading to rapid thermalization. The cause of the sudden collapse of the wave is attributed to the crossing of particles that are accelerated in the direction parallel to the ambient magnetic field by a large pressure-gradient force, $\nabla(B_\perp^2/2\mu_0)$, developed by the instability, where $B_\perp$ is the transverse magnetic field associated with the wave. (auth)

27208 MAGNETOSTATIC EQUILIBRIA OF FINITE-PRESSURE MINIMUM-B PLASMA CONFIGURATIONS. Hall, Laurence S. (Univ. of California, Livermore. Univ. of California, Davis). Phys. Fluids; 15: No. 5, 882-90(May 1972).

Magnetostatic equilibria for a broad class of plasma conditions are shown to correspond to solutions of the equations $\nabla \cdot B = 0$, $\nabla \times H = 0$, where $B = \mu H$. Magnetohydrodynamic stability then corresponds to satisfaction of the criteria $H > 0$ and $dH/dB > 0$, where $B = |B|$ and $H = \mu^{-1}B$. Equilibria are studied for a variety of plasma distributions taken as functions of total energy and magnetic moment and, in the most general cases, the coordinates of a line of magnetic flux. A new result is the determination of a relationship between well depth and the maximum pressure for magnetohydrodynamic stability, which puts an upper limit on the well depth to achieve given pressure when the value of the maximum field strength is fixed. For so-called collisional distributions, if p is the total pressure at the center and B_0 is the maximum magnetic field, $\bar{\beta} = 8\pi p/B_0^2 < 0.2$, and the mirror ratio to achieve maximum $\bar{\beta}$ may not exceed 1.8. More general equilibria, where the pressures are functions of field lines as well, cannot improve the results and may be even more unstable. (auth)

27209 PARAMETRIC INSTABILITIES OF ION CYCLOTRON WAVES IN A PLASMA. Lee, Y. C.; Kaw, P. K. (Princeton Univ., N. J.). Phys. Fluids; 15: No. 5, 911-18(May 1972).

An externally applied large-amplitude circularly polarized ion cyclotron wave of long wavelength propagating along the static magnetic field can drive instabilities of ion cyclotron waves and ion acoustic waves. The dispersion relation is first derived using a kinetic equation approach. Later, it is shown that the same relation can be derived on the basis of a "KΔX" analysis. The instabilities can be classified into three classes: $|k| \gg/k_0$ corresponds to the usual purely growing instability; $|k| \sim k_0$ corresponds to the decay instability, and $|k| \gg k_0$ corresponds to slightly oscillatory instability which is actually the finite k_0 modification of the purely growing instability. The dependence of both the threshold and maximum growth rates on various parameters is discussed. The relevance of the results to the anomalous ion heating for fusion research is also pointed out. (auth)

27210 NONLINEAR SATURATION OF PARAMETRIC INSTABILITY: BASIC THEORY AND APPLICATION TO THE IONOSPHERE. DuBois, D. F. (Hughes Research Labs., Malibu, Calif.); Goldman, M. V. Phys. Fluids; 15: No. 5, 919-27(May 1972).

A calculation is presented of the nonlinear level of Langmuir and acoustic wave plasma fluctuations excited by parametric decay instability, and saturated by induced scattering of the plasma waves from dynamically screened ions (low-frequency spontaneous emission). This is found to be an important weak turbulence saturation mechanism for instabilities excited parametrically in the ionosphere. The cross section for incoherent scattering from the excited waves is obtained and comparisons are made with recent experiments. (auth)

27211 ELECTROMAGNETIC INSTABILITY FOR COUNTER-STREAMING PLASMAS. Hirshfield, J. L.; Bernstein, I. B. (Yale Univ., New Haven). Phys. Fluids; 15: No. 5, 938-9(May 1972).

Growth rates for unstable ordinary polarization electromagnetic waves propagating at right angles to symmetric counterstreaming finite-temperature plasmas are shown to be less than growth rates derived from a slightly modified dispersion relation for cold streams. (auth)

27212 ELECTROSTATIC INSTABILITIES IN PLASMAS AT HARMONICS OF THE ELECTRON CYCLOTRON RESONANCE FREQUENCY. Jacquinot, J.; Leloup, C. (EURATOM-CEA, Fontenay-aux-Roses, France. CEN, Fontenay-aux-Roses, France). J. Phys. (Paris); 32: No. 11, 887-93(Nov-Dec 1971). (In French).

Electrostatic waves propagated in an infinite homogeneous medium consisting of a cold plasma and an anisotropic hot electron population, having a two-temperature Maxwellian distribution, were studied. The maximum growth rate is calculated as a function of the density and the proportion of cold plasma present, for a pressure anisotropy similar to that encountered in most magnetic mirror plasma confinement experiments. The onset of instabilities at harmonics of the electron cyclotron resonance frequency is critically dependent upon the cold plasma density. When the cold plasma density is increased, the instability domain is progressively restricted to narrow density bands. (France)

Thermonuclear Processes

Refer also to abstract 25535.

27213 (LA-4858(Vol.1)) CENTRAL STATION POWER GENERATION BY LASER-DRIVEN FUSION. Booth, L. A. (comp.) (Los Alamos Scientific Lab., N. Mex.). Feb 1972. Contract W-7405-eng-36. 62p. Dep. NTIS.

The feasibility of using laser-driven fusion pulses for the commercial generation of electric power was investigated. Results are presented in two volumes. Volume I (LA-4858-MS, Uncl.) discusses the general aspects of electric power plants based on laser-driven fusion energy sources, outlines the considerations that led to the wetted-wall concept on which the present study is based, presents detailed results of calculations that indicate the feasibility of the concept, discusses aspects of important areas that are not well defined, summarizes related needs for further study, and compares the concept with plants based on magnetically confined controlled thermonuclear reactions. Volume II (LA-4859-MS, Classified, SRD) outlines LASL's laser program, discusses the problems of achieving laser-driven fusion, considers subsequent neutronic interactions, and gives some economic implications. (auth)

27214 (LA-DC-72-125) FIRST-WALL MATERIALS PROBLEMS IN A PULSED FUSION REACTOR. Green, W. V.; Ribe, F. L. (Los Alamos Scientific Lab., N. Mex.). [1972]. Contract W-7405-eng-36. 9p. (CONF-720112-1). Dep. NTIS.

From Fusion first-wall materials meeting; Germantown, Md. (27 Jan 1972).

The conclusions of the panel are given and the properties of a theta-pinch pulsed reactor as presently visualized are summarized. For the case of a shock-heated z pinch the first wall problems would be similar. (M.O.W.)

27215 (TRITA-EPP-71-10) FUSION RESEARCH IN SWEDEN. Lehnert, B. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). 7 Jun 1971. 29p. (CONF-710607-146; CONF-710643-1). Dep. NTIS (U. S. Sales Only).

From fourth conference on plasma physics and controlled nuclear fusion research; Madison, Wis. (17 Jun 1971).

The present status and future plans of Swedish fusion research for the next three years are outlined. After a brief summary of the main fields of activity and general lines of research, a detailed description is given of the specific problems of plasma generation, plasma balance, confinement, stability, plasma heating, and plasma diagnostics. (auth) (Sweden)

27216 DESIGN AND CHARACTERISTICS OF A ROTATING PLASMA DEVICE. Bannenberg, Jan Gerard. Delft, Netherlands; Technische Hogeschool (1971). 103p.

Thesis.

The following chapters are presented: (1) rotating plasmas, (2) design of coils and capacitor bank for generation of the magnetic mirror field, (3) operating characteristics of a fast gas valve, and (4) energy measurements on a rotating plasma. (M.O.W.)

27217 ACCELERATION PROCESSES IN MAGNETO PLASMA DYNAMIC ARCS. Devillers, Pierre Jean. San Diego, Calif.; Univ. of California (1971). 189p. University Microfilms Order No. 72-7588.

Thesis.

The analysis is concerned with the acceleration processes in magnetoplasma dynamic arcs dominated by the self-induced magnetic field. The MPD arc is an electric propulsion device, producing thrust by ionizing an incoming propellant and accelerating the resulting plasma to high exhaust velocities. Two approaches are used to analyze a one-dimensional current sheet, the first by a monofluid model, the second by a multifluid model. The monofluid model is useful to understand the fundamental properties of the one-dimensional analysis. It yields some satisfactory results such as critical mass flow rate, electric field, and exhaust velocity, respectively given by $Q_0 = k\, B_1^2/2\mu_0 M u_c$, $u_1 = k' u_c$, and $E_0 = \frac{5}{6} u_c B$, but indicates restriction to subsonic solutions. A multifluid formulation is necessary to detect the existence of supersonic solutions. The governing equations are written in a general case, then particularized to a simplified model with constant electron temperature and no ion slip. They are parameterized with respect to electric field, mass flow rate and electron temperature, and it is found by computer analysis that supersonic solutions exist only in a narrow range of those parameters, in agreement with experimental findings. The electric field is given by $E_0 = (0.63 \pm 0.03)\, u_c B_1$ the critical mass flow rate by $Q_0 = (1 \pm 0.04) \times (B_1^2/2\mu_0)/Mu_c$, and the electron temperature is found to be 1.60 ± 0.02 eV in argon. For all possible solutions the exhaust velocity is very close to u_c, which provides a theoretical justification for the observed values of exhaust velocities. (TSS) (Diss. Abstr. Int., B)

27218 NEUTRON PHYSICS AND THERMODYNAMICS OF FUSION REACTOR BLANKETS. Daenner, W. (Max-Planck Institut fuer Plasmaphysik, Garching, Ger.). Atomkernenergie; 18: No. 4, 295-9(Dec 1971). (In German).

In the present stage of developing a fusion reactor blanket, neutron physics and thermodynamics are the problems of predominant interest. A short description of the system and its operation mode is followed by a discussion of the problems of tritium breeding and energy release. It is pointed out in which way these characteristic properties are affected by necessary and optional materials present inside the blanket. Finally, some remarks are presented about the specific thermodynamic properties of the blanket and about both the possible modes and the related problems of coupling it to a thermal power cycle. (auth)

27219 CONTROLLED THERMONUCLEAR FUSION. Samain, Andre (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Ind. At.; 15: No. 5, 31-8(Nov 1971). (In French).

The use of controlled thermonuclear fusion in energy production is discussed. The problems encountered by researchers in obtaining favorable operational conditions are outlined. The principal equipment developed in this aim is described. The results obtained in this domain throughout the world are reviewed. (France)

27220 CRITICAL LENGTH CRITERIA FOR MIRROR MACHINES. Berk, H. L. (Univ. of California, Livermore); Pearlstein, L. D ; Cordey, J. G. Phys. Fluids; 15: No. 5, 891-910 (May 1972)

Critical scale lengths for stability of mirror devices are determined. The analysis proceeds via a modified WKB technique, which adds the effect of wave amplification due to the presence of singularities of the dielectric function. The approximate answers so determined compare favorably with the numerical solution of the appropriate equations. Results for large and small mirror ratios are presented. It is found that, irrespective of the character of the wave in the infinite medium limit (e.g., drift-cone or stable negative energy wave), stabilization is effected at roughly the same magnetic scale length for all but the longest axial wavelength modes. (auth)

Wave Phenomena

27221 (AD-733730) TYPES OF INTERACTIONS IN SPACE-TIME PERIODIC MEDIA. Elachi, Charles (California Inst. of Tech., Pasadena. Antenna Lab.). Sep 1971. 27p. (AFOSR-TR-71-2731). NTIS.

The interaction regions between two successive modes in a space-time periodic medium are studied. Geometrical criteria to determine the type of the interactions (stopband, passive, amplifying or self-oscillating) from the $(\alpha_1 - \omega)$ Brillouin diagram are derived by using a first-order Taylor series development in α_1. These criteria are applied to the cases of sinusoidally space-time periodic dielectric, plasma and uniaxial plasma; then the criteria are generalized for the case of generally space-time periodic media. (auth) (NTIS)

27222 (AD-733857) PARAMETRIC COEXCITATION OF ION-ACOUSTIC WAVES AND ELECTRON PLASMA WAVES BY A HIGH-FREQUENCY ELECTRIC FIELD. Stowe, David William (Illinois Univ., Urbana. Coordinated Science Lab.). Sep 1971. Contract DAAB07-67-C-0199. 101p. (UILU-ENG-71-2237). NTIS.

The basic theory of parametric coexcitation of ion-acoustic and electron plasma waves by a high-frequency electric field is reviewed. Numerical calculations show that plasma-neutral collisions and steady-state drift velocities have a significant influence on the interaction. Parametric excitation of ion acoustic waves is observed experimentally in a helium dc discharge. The observations indicate that the radial density profile of the dc discharge modifies the parametric effect. In the absence of an applied field, unstable electron drift-excited ion-acoustic waves are experimentally observed. These waves are found to satisfy the dispersion relation for a plasma consisting of He^+ and He_2^+. (auth)

27223 (AD-733908) THREE WAVE COUPLING IN A COLD BEAM-PLASMA SYSTEM. Tanaka, S.; Raether, M. (Illinois Univ., Urbana. Coordinated Science Lab.). Oct 1971. Contract DAAB07-67-C-0199. 61p. (UILU-ENG-71-2239). NTIS.

The coupling of three fixed-phase waves in a cold beam-plasma system is discussed for all cases that result from locating the waves on the positive and negative energy branch. Explicit expressions are given for the spatial variation of the wave amplitudes, including the influence of wave number mismatch and spatial growth rates. The coupling constants are computed for the decay and the explosive mode for representative beam and plasma parameters. (auth)

27224 (AD–733909) EXPERIMENTAL OBSERVATION OF WAVE–WAVE COUPLING IN A BEAM–PLASMA SYSTEM. Chang, J.; Raether, M.; Tanaka, S. (Illinois Univ., Urbana. Coordinated Science Lab.). Sep 1971. Contract DAAB07-67-C-0199. 18p. (UILU-ENG-71-2231). NTIS.

The interaction between unstable waves was investigated in a beam–plasma system under conditions such that nonlinear wave–particle interactions are negligible. At small wave amplitudes the results can be interpreted in terms of a simple three-wave decay process; at large amplitudes the situation is dominated by multiple wave coupling that leads to generation of satellite waves. (auth) (NTIS)

27225 (AD–733977) COMPUTER STUDIES OF COLLISIONLESS DAMPING OF A LARGE AMPLITUDE WHISTLER WAVE. Ossakow, S. L.; Haber, I.; Sudan, R. N. (Naval Research Lab., Washington, D. C.). Nov 1971. 13p. (NRL-MR-2362). NTIS.

The computer simulation of a single large-amplitude whistler wave propagating in a plasma was carried out. Such a wave shows an initial linear damping, then a regrowth and amplitude oscillation, and finally it settles to a constant-amplitude value. These features are in good agreement with the theory. (auth) (NTIS)

27226 (KHFTI-71-9) TOWARD A THEORY OF THE NONLINEAR INTERACTION OF ION-ACOUSTIC WAVES WITH ELECTRONS. Dolgopolov, V. V. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1971. 25p. (In Russian). Dep. NTIS (U. S. Sales Only).

Where the ratio of the energy density of the ion-acoustic oscillations with chaotic phases to the thermal electron energy density is sufficiently less than the square root of the ratio of the electron mass to the ion mass, the nonlinear correction to the linear increment is small in comparison to the linear increment. In the reverse case, the theory of weak nonlinearity and the linear theory are not applicable. (tr-auth)

27227 (N–71-36050) ELECTROMAGNETIC PLASMA WAVE PROPAGATION ALONG A MAGNETIC FIELD. Olson, Craig L. (California Univ., Los Angeles. Plasma Physics Group). Sep 1970. Contracts N00014-69-A-0200-4023; AT(04-3)-34. 41p. (NASA-CR-121918). NTIS.

The linearized response of Vlasov plasma to the steady-state excitation of transverse plasma waves along an external magnetic field is examined by an idealized delta function mechanism. The response was found to consist of three terms-branch cut, a free stream, and dielectric pole. These terms are examined analytically and numerically evaluated for a case in which the driving frequency is slightly below the electron cyclotron frequency. The effects of Kroof model collisions are investigated as well as the effects of a finite-width excitation mechanism. Steady-state transverse plasma-wave echoes are also determined using the Vlasov–Maxwell equation. It is shown that a transverse echo results in lowest order only when one excitation is transverse and the other longitudinal. Several extensions, effects of Fokker–Planck collisions and finite width excitation mechanisms, effects of temporary anisotropy, and the effects of propagation just-off axis, are examined. Transverse echoes for the case of no external magnetic field are also considered. (auth) (STAR)

27228 (UARAEE-120) SHOCK WAVE IN A LONGITUDINAL MAGNETIC FIELD. El-Khalafawy, T. A.; Masoud, M. M.; Zemskov, A. I. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Accelerators and Plasma Physics Research). 1971. 17p. Dep. NTIS (U. S. Sales Only).

The longitudinal magnetic field effect on the propagation velocity and ionizing shock-wave structure was studied. The quasi-stationary magnetic field amounted to 7 kG. The hydrogen pressure varied in the range 3×10^{-3} to 10^{-1} m torr. The shock tube diameter and length were 4 cm and 80 cm, respectively. (M.O.W.)

27229 EXACT THEORETICAL TREATMENT OF CYCLOTRON ECHOES FOR RAMSAUER GASES. Bachmann, P.; Baumgaertel, K.; Sauer, K. (Zentralinstitut fuer Elektronenphysik, Berlin). Lett. Nuovo Cim.; 3: No. 4, 161-5(22 Jan 1972).

Calculations were made using the dynamical equation for a charged particle situated in a region of the magnetic field with the local cyclotron frequency ω_c: $\ddot{\vec{v}} + \tilde{\omega}_0 \times \dot{\vec{v}} = a(t) - \nu(\dot{v})\dot{\vec{v}}$ where $a = e/mE$, $\tilde{\omega}_c = \omega_c e_z$, and E is the external electric field. (M.O.W.)

27230 EFFECT OF INHOMOGENEITY ON ELECTROSTATIC OSCILLATIONS OF MULTI-VELOCITY ELECTRON STREAMS. Sedlacek, Z. (Inst. of Plasma Physics, Prague). Czech. J. Phys.; 22: No. 1, 67-76(1972).

The dispersion relations for electrostatic oscillations of an inhomogeneous beam with a longitudinal velocity spread and of two counter-streaming inhomogeneous beams are investigated. In both cases the effect of the inhomogeneity is to extinguish the discrete spectrum entirely and to make the dispersion function a multivalued analytic function: a pair of branch points is created, each corresponding to zero of the dispersion function of the associated homogeneous problem. The zeros themselves do not vanish but move on other sheets of the Riemannian surface of the dispersion function. The result is, physically, that the Landau damping is enhanced and the aperiodic two-beam instability becomes an over-stability. (auth)

27231 HELICAL SLOW-WAVE SYSTEM WITH AN INHOMOGENEOUS PLASMA. Ivanova, V. D. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 16: No. 5, 896-8 (May 1971).

Translated from Radiotekh. Elektron.; 16: No. 5, 877-9 (May 1971).

In studying the effect of a plasma on the properties of helical slow-wave systems (SWS) it is interesting to consider the case when the SWS adjoins an inhomogeneous plasma since, in practice, a plasma is never homogeneous, especially in the transition layer at the helix surface. The helical SWS is studied in the approximation of an anisotropically conducting plane (conduction is at an angle $\pi/2 - \psi$ with respect to the wave propagation direction), on one side of which there is an inhomogeneous plasma with properties that vary in a direction normal to the helix surface. (M.O.W.)

27232 THEORY OF WAVES IN INHOMOGENEOUS MAGNETOPLASMAS. Sivasubramanian, Arunachalam. Amherst, Mass.; Univ. of Massachusetts (1971). 134p. University Microfilms Order No. 72-10,112.

Thesis.

The linearized Vlasov equation for a hot magnetoplasma is solved through the particle-orbit theory, using the techniques of Fourier transform. An analytical, integral expression is obtained for the current density for waves propagating across the static magnetic field. When inverse Fourier transforms, it gives rise to an infinite-order differential expression with terms of the order of powers of (r_c/λ) and (r_c/L), where r_c is the effective electron thermal Larmor radius, λ is the effective wave length, and L is the scale length of inhomogeneity. The differential equations obtained for the electric field of the wave are compared with those derived by earlier authors, and the differences are pointed out. The general theory is extended to include the effects of the d.c. ambipolar field and two-dimensional inhomogeneities. The results that are obtained in these cases are found not to differ significantly from the ones derived with the simpler one-dimensional model. As an application of the theory, numerical solutions are obtained for the integral equations to study the Buchsbaum–Hasegawa resonances in an inhomogeneous magnetoplasma. The results are found to compare very favorably with the experimental data available. Distributional solutions signifying traveling waves are also obtained for a different electron number density profile. The problem of mode conversion across the upper hybrid resonance is enumerated. An asymptotic theory is presented to obtain the transmission and reflection coefficients for wave propagation through the inhomogeneous plasma. (Diss. Abstr. Int., B)

27233 INDUCED COMPTON SCATTERING AND NONLINEAR PROPAGATION IN LASER-CREATED PLASMAS. Decroisette, M.; Peyraud, J.; Piar, G. (Centre d'Etudes de Limeil, Villeneuve-Saint-George, France). Phys. Rev., A; 5: No. 3, 1391-6(Mar 1972).

Evidence was obtained of the induced scattering of an electromagnetic wave by Compton collisions, and of its nonlinear propagation in a plasma. The interpretation of the modified spectral profile of the interacting radiation is compatible with plasma parameters. (auth)

27234 EFFECTS OF ELECTRON–NEUTRAL COLLISIONS ON PROPAGATION OF ELECTRON PLASMA WAVES. Kawabe, T. (Tokyo Univ.); Kawai, Y.; Saka, O.; Nakamura, Y.; Dawson, John M. Phys. Rev. Lett.; 28: No. 14, 889-92(3 Apr 1972).

The propagation of electron plasma waves was studied experimentally in the regime where electron–neutral collisions dominate. It was found that the effects of collision not only enhance the damping of the wave, but also increase the wave number for a given frequency. These results are compared with some theoretical models. (auth)

27235 SCATTERING OF MICROWAVES FROM PLASMA WAVES EXCITED IN AN ELECTRON BEAM–PLASMA INTER-

ACTION. Bollinger, Lynn David. Urbana, Ill.; Univ. of Illinois (1971). 95p. University Microfilms Order No. 72-6869.

Thesis.

The process of incoherent scattering of microwaves from plasma waves is used to investigate the spatial development of the unstable longitudinal fluctuation spectrum of plasma electrons excited by an electron beam in a plasma in the absence of an external magnetic field. The most unstable plasma waves propagating at any angle to the beam direction are found to have a phase velocity approximately equal to the projection of the beam velocity in that direction and are thus directly excited by the beam. The effect of a finite beam radius on the instability is experimentally determined, and it is found that this effect is modified as the instability develops. Microwave scattering from the harmonic of the plasma wave is observed and the dispersion behavior of the harmonic wave is measured. Experiments comparing the radiation emitted by the plasma waves to the microwaves scattered from the plasma waves are in agreement with a theory by Ichimaru and Starr. (Diss. Abstr. Int., B)

27236 PARAMETRIC-AMPLIFICATION MECHANISM FOR ION-ACOUSTIC OSCILLATIONS IN A WEAKLY IONIZED PLASMA IN AN ALTERNATING ELECTRIC FIELD. Barkhudarov, E. M.; Kervalishvili, N. A.; Kortkhondzhiya, V. P.; Tsintsadze, N. L.; Tskhakaya, D. D. (Inst. of Physics, Tbilisi, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 10, 1612-15(Apr 1972).

Translated from Zh. Tekh. Fiz.; 41: No. 10, 2035-9(Oct 1971).

It is shown experimentally that the parametric amplification of ion-acoustic oscillations in a weakly ionized plasma subject to an alternating electric field at a frequency below the ion plasma frequency is attributable to modulation of the charged particle density. The resonance width and the growth rate were calculated. The calculated resonance width is in good agreement with the experimental value. (auth)

27237 EFFECT OF MAGNETIC FIELDS ON ACOUSTIC OSCILLATIONS IN A LOW-TEMPERATURE PLASMA. Asinovskii, E. I.; Sinkevich, O. A. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 9: No. 4, 634-42(Jul-Aug 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 4, 694-702(Jul-Aug 1971).

The effect of powerful magnetic fields and high electric current densities on acoustic oscillations which propagate in a plane perpendicular to the unperturbed magnetic field is investigated. The unperturbed medium is inhomogeneous. It is shown that the possibility exists of suppressing the instability of the medium by means of a powerful magnetic field. The boundaries of the stability domains are given. (auth)

27238 REFLECTION AND REFRACTION OF ELECTROMAGNETIC WAVES BY MOVING IONIZATION REGION. Sorokin, Yu. M.; Stepanov, N. S. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 14: No. 5, 686-9(1971). (In Russian).

The interaction of electromagnetic waves with uniformly moving ionization region in immovable medium is considered. It is shown that the reflection and refraction coefficients may be expressed through the corresponding coefficients for the immovable plasma layer of the analogous profile. The relations obtained contain total energies and frequencies of interacting waves at different velocities of the ionization wave. Unlike the moving inhomogeneous plasma, the total signal energy and the quantum number decrease in all cases. (auth)

27239 ABSORPTION OF AN ELECTROMAGNETIC WAVE BY A HALF-SPACE OF MAGNETOACTIVE PLASMA. Klavdiev, V. V. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 14: No. 5, 680-5 (1971). (In Russian).

The absorption coefficients of an ordinary electromagnetic wave at oblique incidence on the magnetoactive plasma half-space are calculated by the energetic method according to the field work on the plasma particles. The models of mirror and diffusion scattering of particles at the plasma boundary are considered. A simple physical explanation of the results obtained is given. (auth)

27240 ASYMMETRIC SIDEBANDS OF LOW FREQUENCY WAVES IN A CURRENT CARRYING PLASMA. Takamura, Shuichi; Tanaka, Yuji; Okuda, Takayoshi (Nagoya Univ., Japan). Jap. J. Appl. Phys.; 11: No. 4, 572-7(Apr 1972).

When ion waves are excited externally in a plasma through which temporally modulated electron and ion streams flow, the spectrum of the received signal, which contains the upper and the lower sidebands spaced by the modulation frequency, is not symmetric with respect to the exciting frequency. These phenomena are explained by the combination of the amplitude modulation and the frequency one. (auth)

27241 WAVE PROPAGATION AND DAMPING IN A HOT, BOUNDED PLASMA. Cato, James Earl. Lubbock, Tex.; Texas Tech. Univ. (1971). 119p. University Microfilms Order No. 72-10,342.

Thesis.

A theoretical technique was developed whereby finite temperature effects can be easily included into the bounded, plasma wave propagation problem. The technique employs the hot plasma theory as outlined by Stix and retains terms through some specified order in the hot plasma expansion parameter λ. Thus for some fixed integer M, terms with order greater than λ^M are assumed negligible and are not retained in the calculations. The cold plasma theory, including zero-order temperature-correction terms, results with $M = 0$. With $M \geq 1$, additional temperature correction terms are introduced. The number of terms one retains is limited only by the complexity of the problem and the number of boundary conditions that can be formulated. Numerical calculations are presented for $M = 1$ concerning the fast plasma wave propagating near the second harmonic of the ion cyclotron frequency (i.e., $\omega \simeq 2\Omega_i$). The inclusion of first-order temperature-correction terms shows that the fast wave should experience a strong spatial damping at $\omega = \Omega_i$. Since the fast wave is easily excited and can propagate at the higher plasma densities, such a damping mechanism may have fusion plasma heating applications. Some evidence of this fast wave damping was obtained experimentally. The results, however, are not as detailed as were desired because of the strong collisional damping in the high-density ($>10^{20}$ m^{-3}), low-temperature (~3 eV) experimental plasma. It appears that only by increasing the electron temperature can collisional effects be eliminated to allow a more detailed study of the fast wave near $\omega = \Omega_i$. (TSS) (Diss. Abstr. Int., B)

27242 NUMERICAL STUDY OF STRONG PLASMA SHOCK WAVES PRODUCED IN AN ELECTROMAGNETIC SHOCK TUBE. Schneider, S. H. (Columbia Univ., New York). Phys. Fluids; 15: No. 5, 805-14(May 1972).

A set of two-fluid Navier–Stokes equations with classical physical transport coefficients is used to compute the evolution and structure of collisional plasma shock waves in an electromagnetic shock tube. Shock speeds up to 200 cm/μsec and shocked-plasma temperatures of the order of kilovolts are studied. A strong transverse-bias magnetic field employed significantly alters the size and shape of the shock profiles, when compared with the zero-bias field case. The wave structure is different from that of a two-fluid gasdynamic shock without transverse magnetic field. Especially significant is the effect of the small ion Larmor radius in reducing the gasdynamic shock thickness by at least an order of magnitude in the transverse shock case, which permits collisional shocks to have thicknesses much smaller than the post-shock mean free path. These collisional shock waves produce very hot ions, the ion temperature increasing with shock speed, although the formation time and distances also increase substantially with shock speed. Generally, the results compare favorably with electromagnetic shock tube experimental data. (auth)

27243 NONLINEAR FREQUENCY SHIFT OF A PLASMA WAVE. Dewar, R. L.; Lindl, J. (Princeton Univ., N. J.). Phys. Fluids; 15: No. 5, 820-4(May 1972).

The effect of nonlinearity on the dispersion relation of an electron plasma wave is investigated experimentally by numerical simulation and theoretically by perturbation expansion and use of Hamilton's variational principle. The simulation was carried out using a one-dimensional water-bag distribution of finite-size electrons, and the theory takes this into account by using a fluid-type Lagrangian with a nonlocal field–particle interaction. The first-order (in wave energy) correction coefficient in the nonlinear dispersion relation was measured as a function of wavelength, and reasonable agreement was found with the theory in both the traveling and standing-wave cases. (auth)

27244 EXPERIMENTAL STUDIES OF ELECTROSTATIC FLUCTUATIONS IN A TURBULENTLY HEATED PLASMA. Hamberger, S. M.; Jancarik, J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Fluids; 15: No. 5, 825-36 (May 1972).

Experiments are described in which the spectra of potential fluctuations in a toroidal discharge are measured under conditions of turbulent heating using a small double electrostatic probe. Three different turbulent regimes are distinguished whose occurrence depends on the electron drift velocity and which correspond, respectively, to the excitation of ion sound, two-stream, or beam–plasma instability. The spectral distribution in the case

of weakly turbulent ion sound waves agrees with nonlinear theory. The frequency of the strongly turbulent two-stream oscillations appears in the vicinity of the predicted fastest growth frequency $f^* = {}^1/_2 (M/m)^{1/3} f_{pi}$. The relationship of the fluctuations and their correlation times with the effective conductivity is discussed. (auth)

27245 ABSORPTION OF AN ELECTROMAGNETIC WAVE NORMALLY INCIDENT ON A WARM PLASMA. Arumi, F. N.; Oakes, M. E. (Univ. of Texas, Austin). Phys. Fluids; 15: No. 5, 837-44(May 1972).

A theoretical analysis of an electromagnetic wave incident on a warm, homogeneous plasma half-space is reported. A static magnetic field is parallel to the plasma surface. Collisions are included to discuss several experiments; however, the approach is not restricted to collision-dominated systems. Particular attention is given to the plasma–vacuum boundary conditions. (auth)

27246 COMPUTER SIMULATION OF ION-ACOUSTIC SHOCKS. II. SLUG AND PISTON PROBLEMS. Mason, R. J. (Bell Telephone Labs., Inc., Whippany, N. J.). Phys. Fluids; 15: No. 5, 845-53(May 1972).

Particle-in-cell computer simulation techniques are applied to the study of ion-acoustic shocks in (a) the expansion of a narrow plasma slug, and (b) the flow produced by an impulsively started piston. Electrons are treated as an isothermal fluid. The slug fissions into pulses with structure dependent on $\theta(=T_e/T_i)$. Pulse reflection from a specular boundary is characterized. For piston Mach numbers $M_p = 0.25 \rightarrow 1.25$ shocks from Mach 1.10 to 1.42 are generated. The shocks are initially laminar, but an apparent onset for turbulence is observed. Jump conditions are consistent with results from previous investigations of the diaphragm problem. (auth)

27247 COLLISIONAL THEORY OF SHOCK AND NONLINEAR WAVES IN A PLASMA. Hu, Pung Nien (Aeronautical Research Associates of Princeton, Inc., N. J.). Phys. Fluids; 15: No. 5, 854-64(May 1972).

The unsteady-state problem of weak nonlinear plasma waves in the presence of a perpendicular magnetic field is studied, based on a system of moment equations of Boltzmann equations for electrons and ions. This system, rigorously closed and obtained by proper scalings in time and space with respect to the wave strength describes a fully ionized plasma with all possible dissipative mechanisms, including electron and ion viscosity, coupled electron and ion heat conduction, thermal diffusion and resistivity, as well as all the distinct Hall effects. In all the plasma parameter ranges, it is found that the evolution of weak nonlinear waves is governed by the Burgers equation, subject to given initial and boundary conditions. The formation of a shock wave and the evolution of a compression pulse are studied in detail. The transit time and distance for a fully developed shock wave are obtained, both being complicated functions of plasma parameters. In some parameter ranges, the transit time is smaller than the electron self-collision time while the transit distance is smaller than the mean free path. The time scale for the evolution of a compression pulse depends strongly on its initial width. A steady shock front will shortly appear if the initial width of the pulse is large compared with the thickness of a steady shock wave. On the other hand, the pulse will immediately decay if its initial width is small compared with the thickness of a steady shock wave. Depending on the parameter range, the thickness of a steady state shock wave can be larger than, comparable to, or smaller than the mean free path. Eventually, however, a compression pulse becomes self-similar, with its amplitude decaying as $1/t^{1/2}$ and its width spreading as $t^{1/2}$. The inclusion of the electron inertia effect leads to the Korteweg–de Vries–Burgers equation which covers a wide range of wave profiles. (auth)

27248 PRECURSOR OF ION-ACOUSTIC QUASISHOCK WAVE IN COLLISIONLESS PLASMA. Kato, Yusuke (Kobe Univ., Japan); Tajiri, Masayoshi; Taniuti, Tosiya. Phys. Fluids; 15: No. 5, 865-70(May 1972).

A weak, ion-acoustic quasi-shock wave that propagates into a uniform state is considered. A relevant initial-value problem of the Vlasov equation is solved to give the long-time behavior of a precursor, which is a stream of ions reflected by the electrostatic potential. An asymptotic expansion in terms of the small amplitude is used. The ratio of the ion temperature to the electron temperature is assumed small so that effects of the reflected ions appear as a correction to the Korteweg–de Vries equation, which governs the wave propagation due to the nonresonant ions. The connection with the stationary solution is examined. (auth)

27249 COMPUTER STUDIES OF COLLISIONLESS DAMPING OF A LARGE AMPLITUDE WHISTLER WAVE. Ossakow, S. L.; Haber, I.; Sudan, R. N. (Naval Research Lab., Washington, D. C.) Phys. Fluids; 15: No. 5, 935-7(May 1972).

Computer simulation of a single large-amplitude whistler wave propagating in a plasma was carried out. Such a wave shows an initial linear damping, then a regrowth and amplitude oscillation, and finally settles to a constant-amplitude value, all in good agreement with theory. (auth)

27250 SCATTERING OF ELECTROMAGNETIC WAVES FROM A TURBULENT PLASMA SLAB. Liu, C. H. (Univ. of Illinois, Urbana). Phys. Fluids; 15: No. 5, 939-41(May 1972).

Scattering of electromagnetic waves from a turbulent plasma slab is studied. Part of the effects of the multiple scattering is taken into account. The reflection coefficient is found to be increased and its variation with respect to the slab thickness is smoothed out by the random scattering. (auth)

27251 MICROWAVE SCATTERING FROM UNDERDENSE AND OVERDENSE TURBULENT PLASMAS. Attwood, David (New York Univ., Bronx). Phys. Fluids; 15: No. 5, 942-4(May 1972).

Experimental results of microwave scattering from a turbulent plasma are presented. As electron density is increased beyond the critical value, a transfer from volume to surface scattering is observed. Overdense scattering is characteristic of a cylinder displaying orientation fluctuations. (auth)

27252 COMPARISON OF THE LOW-FREQUENCY EIGENMODES OF A CYLINDRICAL PLASMA WITH EXPERIMENTAL PARAMETRICALLY EXCITED PLASMAS. Fredericks, R. M. (Bell Telephone Labs., Holmdel, N. J.); Asmussen, J. Jr. Phys. Fluids; 15: No. 5, 944-6(May 1972).

The low-frequency eigenfrequencies and electron temperatures of a cylindrical plasma are calculated and are compared with experimental parametrically excited plasma cylinders. The agreement between theory and experiment indicates that certain refinements of the theory must be made. (auth)

27253 MODULATION OF MICROWAVES PROPAGATING THROUGH A RADIO-FREQUENCY PLASMA SUBJECTED TO A PERPENDICULAR LOW-INTENSITY TIME-DEPENDENT MAGNETIC FIELD. Kumar, S.; Sarkar, D. C. (Aligarh Muslim Univ., India). Physica; 58: No. 3, 384-92(1 Apr 1972).

Radio-frequency electric power absorbed by a plasma, in the presence of a low-intensity perpendicular magnetic field, shows a variation with the intensity of the applied magnetic field and a resonance at electron cyclotron frequency equal to the frequency of the electric field. If such an rf plasma is subjected to a perpendicular low-intensity time-dependent magnetic field, then the rf electric power absorbed by the plasma will follow the periodic variation of the magnetic field. This periodic variation in rf power absorbed by the plasma will lead to a periodic variation in the plasma parameters, such as electron density and elastic collision frequency of electron and molecule. A microwave propagating through such a plasma, possessing periodically varying parameters, will evidently become amplitude-modulated. Important theoretical aspects of this problem are investigated, and the modulation impressed upon the microwave propagating through such a plasma is computed for various cases. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 26838, 26840, 27187, and 27264.

27254 (DNA-1892-3(Rev.1)) WEAPONS RADIATION SHIELDING HANDBOOK. CHAPTER 3. METHODS FOR CALCULATING NEUTRON AND GAMMA-RAY ATTENUATION. Stevens, Paul N.; Trubey, David K. (Oak Ridge National Lab., Tenn.). Mar 1972. 179p. Dep. NTIS.

Formerly DASA-1892-3.

Calculations of the attenuation of neutrons and gamma rays in shields can be performed by several techniques, the best technique for a particular problem depending on the type of problem to be solved and the degree of accuracy required. This chapter of the Handbook surveys the calculational methods used most frequently and provides summaries of digital computer codes based on the various methods. The methods covered are those of spherical harmonics, discrete ordinates, moments, Monte Carlo, diffusion theory, invariant imbedding, and kernels, plus a method which combines a removal kernel with diffusion theory. Except for the invariant imbedding method, all these techniques are either approximate solutions to the well-known Boltzmann equation or are based on kernels obtained from solutions to the equation. A discussion of the Boltzmann equation is also included in the chapter. (25 tables, 42 figures, 215 references) (auth)

27255 (N-71-35899) PENETRATION OF HIGH-ENERGY RADIATION. (National Bureau of Standards, Washington, D. C.). 1 Sep 1971. 5p. (NASA-CR-119939). NTIS.

A set of computer programs for calculating the penetration and diffusion of electrons and associated bremsstrahlung through extended media was developed. A brief summary of the programs and their applications is presented with a list of publications. (STAR)

27256 (N-72-12682) FASTER 3: A GENERALIZED-GEOMETRY MONTE CARLO COMPUTER PROGRAM FOR THE TRANSPORT OF NEUTRONS AND GAMMA RAYS. VOLUME 1. Summary Report. Jordan, Thomas M. (A.R.T. Research Corp., Los Angeles, Calif.). 15 Dec 1970. Contract NAS3-14400. 51p. (NASA-CR-124636; ART-45(Vol.1)). NTIS.

The theory used in FASTER-III, a Monte Carlo computer program for the transport of neutrons and gamma rays in complex geometries, is outlined. The program includes the treatment of geometric regions bounded by quadratic and quadric surfaces with multiple radiation sources that have specified space, angle, and energy dependence. The program calculates, using importance sampling, the resulting number and energy fluxes at specified point, surface, and volume detectors. It can also calculate minimum weight shield configuration meeting a specified dose rate constraint. Results are presented for sample problems involving primary neutron, and primary and secondary photon transport in a spherical reactor shield configuration. (auth) (STAR)

27257 (N-72-12683) FASTER 3: A GENERALIZED-GEOMETRY MONTE CARLO COMPUTER PROGRAM FOR THE TRANSPORT OF NEUTRONS AND GAMMA RAYS. VOLUME 2. USER'S MANUAL. Jordan, Thomas M. (A.R.T. Research Corp., Los Angeles, Calif.). 16 Nov 1970. Contract NAS3-14400. 200p. (NASA-CR-124637; ART-45(Vol.2)). NTIS.

A description of the FASTER-III program for Monte Carlo calculation of photon and neutron transport in complex geometries is presented. Major revisions include the capability of calculating minimum weight shield configurations for primary and secondary radiation and optimal importance sampling parameters. The program description includes a users manual describing the preparation of input data cards, the printout from a sample problem including the data card images, definitions of Fortran variables, the program logic, and the control cards required to run on the IBM 7094, IBM 360, UNIVAC 1108, and CDC 6600 computers. (auth) (STAR)

27258 GENERATION, CHARACTERISTICS, AND SHIELDING OF X-RADIATION PRODUCED IN HIGH-VOLTAGE RECTIFIER AND SHUNT REGULATOR TUBES IN TELEVISION SETS. Richardson, J. R. (General Electric Co., Owensboro, Ky.). IEEE (Inst. Elec. Electron. Eng.), Trans. Broadcast Telev. Receivers; BTR-17: No. 4, 232-8(Nov 1971).

Present knowledge of the mechanisms affecting the generation, absorption, and scattering of x radiation from high-voltage, vacuum-tube regulators and rectifiers used in television receivers is summarized. In particular, calculations and experimental data showing the effects of absorption and scattering on the energy distribution of the x-rays will be discussed. On the basis of the above properties of the radiation, the design of appropriate shieldings for rectifiers and regulators in television receivers is outlined. (auth)

27259 PENETRATION OF LOW-ENERGY PROTONS THROUGH THIN FILMS. Cano, Gilbert L. (Sandia Labs., Albuquerque, N. Mex.). J. Appl. Phys.; 43: No. 4, 1504-7 (Apr 1972).

Protons of energy 10 to 30 keV impinged on free-standing films of Au, Er_2O_3, and Sc_2O_3 of thickness 150 to 650 Å. Results are reported of the stopping power, energy, and angular spread of the transmitted beam. Stopping power results obtained and theoretical predictions are only in qualitative agreement. (auth)

27260 SPECTRA OF CHARACTERISTIC ELECTRON-ENERGY LOSSES IN GADOLINIUM AND DYSPROSIUM. Tsveiman, E. V.; Red'kin, V. S.; Zashkvara, V. V.; Korsunskii, M. I. (Inst. of Nuclear Physics, Alma-Ata, USSR). Sov. Phys.-Solid State (Engl. Transl.); 13: No. 9, 2339-40(Mar 1972).

Translated from Fiz. Tverd. Tela; 13: No. 9, 2793-5(Sep 1971).

Reflection of an electron beam of energy 150 to 600 eV from a bulk sample was used to obtain the characteristic energy-loss spectra of Gd and Dy at scattering angles of 39 and 141°. The Auger peak of oxygen was removed by heating to 1000°C. The probable cause of each of the four or five peaks (plasmons in bulk and oxide film) is discussed. (D.L.C.)

27261 ENERGY LOSSES BY SLOW ELECTRONS IN ALKALI HALIDE FILMS. Hiraoka, Kenzo; Hamill, William H. (Univ. of Notre Dame, Ind.). J. Chem. Phys.; 56: No. 6, 3185-6(15 Mar 1972).

The interactions of electrons with KCl and NaCl films at energies up to 15 eV were examined by measuring backscattered and absorbed currents. Possible interpretations of the resonance bands observed are suggested. (A.G.W.)

Radiation Protection Standards

Refer also to abstracts 25800, 25901, and 25904.

27262 RADIATION QUANTITIES AND UNITS. Washington, D. C.; International Commission on Radiation Units and Measurements (1971). 27p. $2.50. (ICRU-19).

The detailed considerations relating to physical radiation quantities are discussed under the subjects: stochastic quantities and nonstochastic quantities and spectra and mean values. Under quantities and units for use in radiation protection, the general considerations, dose equivalent, and specification of ambient radiation levels are covered. This report supercedes JCRV Report 11. The major changes are: introduction of additional quantities particularly in the areas of microdosimetry and radiation protection; and more rigorous definitions of the quantities resulting in a somewhat different formalism without altering their meaning or range of applicability. (M.H.R.)

Radiation Source Calibration and Standardization

Refer also to abstracts 25570 and 26845.

27263 NEUTRON ENERGY SPECTRA OF DIFFERENT SIZE $^{239}Pu-Be(\alpha,n)$ SOURCES. Anderson, M. E.; Neff, R. A. (Monsanto Research Corp., Miamisburg, Ohio). Nucl. Instrum. Methods; 99: No. 2, 231-5(1972).

Neutron energy spectra were measured for $^{239}Pu-Be$ sources containing 2, 14, 80, and 160 g of Pu. Intensity maxima near 2.0, 3.1, 4.8, 6.6, 7.7, and 9.8 MeV were seen in all spectra, and a small maximum near 1.4 MeV was seen in two of the spectra. The principal differences between these spectra are in the energy region 0 to 3 MeV, with the larger sources having the higher percentages of neutrons in this region. A single stilbene crystal, fast-neutron spectrometer and a long counter were used for these

measurements. The spectrum of the 80-g source had previously been determined with the use of nuclear emulsions. The agreement between the emulsion spectrum and the present measurements of this source is quite close. (auth)

Shielding Calculations and Theory

Refer also to abstracts 27254, 27256–27258, and 27385.

27264 CALCULATION OF γ-RADIATION FIELDS IN STATISTICALLY INHOMOGENEOUS MEDIA USING THE MONTE CARLO METHOD. Kol'chuzhkin, A. M.; Uchaikin, V. V. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz. No. 3, 65-8(1971). (In Russian).

A study was made of the problem of calculating the radiation field in a medium of random inhomogeneity. Using perturbation theory an algorithm was obtained for the solution of this problem by the Monte Carlo method. (tr-auth)

27265 EXPERIENCES AND PROBLEMS ON DESIGN AND CONSTRUCTION OF RADIATION SHIELDING. 2. RADIATION SHIELDING FOR RI-IRRADIATION FACILITIES. Kasamatsu, Tomomichi (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 13: No. 7, 392-6(Jul 1971). (In Japanese).

The problems of the γ-ray shielding are presented from the standpoint of practical use, giving some actual examples. First, the general laws and analysis method of γ-ray shielding are explained briefly, and primary γ-ray shielding, both with concrete and with such pulverized materials as sand, is described. Next, a method is presented for γ-ray shielding that utilizes scattering and reflection, and results with some actual examples are given. Finally, radiation shielding for radiation facilities of industrial scale is mentioned. (Japan)

PHYSICS (SOLID-STATE)

27266 MODERN ASPECTS OF SOLID STATE CHEMISTRY. Rao, C. N. R. (ed.). New York; Plenum Publishing Corporation (1970). 637p. $27.50.

Twenty-two lectures presented at the Winter School in Solid State Chemistry held in Kanpur, India, on Nov. 25 to Dec. 15, 1969 are included. Some of the topics covered were lattice dynamics, defects, ionic solids, dielectrics, magnetism, NMR, disorder, diffusion, electric properties, solid-state reactions, band and transport theories, and phase transformations. Separate abstracts were prepared for the three lectures dealing with NMR in superconductors and dilute alloys, Moessbauer effect in dynamics of atomic motion in solids, and positron annihilation in solids. (D.L.C.)

For abstracts of individual papers see: 27301, 27343, and 27344.

Radiation Effects

Refer also to abstracts 26125 and 26174.

27267 (AD–733446) RADIATION EFFECTS IN SILICON AND GERMANIUM. Final Report, February 26, 1969–September 15, 1971. Srour, J. R.; Curtis, O. L. Jr.; Othmer, S.; Rauch, R. B. (Northrop Corporate Labs., Hawthorne, Calif.). Aug 1971. Contract DAAG39-69-C-0039. 203p. (NCL–71-29-R; HDL–69-39-2). NTIS.

Recombination parameters are determined for ^{60}Co gamma-irradiated n-type germanium (low resistivity) and n-type silicon. A study of transient photoconductivity decay in the presence of traps for both irradiated and unirradiated silicon and germanium is presented. Measurements of the injection-level dependence of minority-carrier lifetime for n- and p-type silicon with neutron dose as a parameter are reported. Useful relationships for recombination studies are presented, including a method for determining capture-probability temperature dependences. Short-term annealing studies include an investigation of transient recovery in p-type silicon following pulsed 1.4-MeV electron irradiation and an analytical treatment of the effects of metastable charge states on short-term annealing in p-type material. Data presented indicate that heat-treated Czochralski-grown Al-doped silicon that undergoes an appreciable resistivity increase during heating at 450°C is significantly more resistant to both neutron and gamma irradiation than B-doped material. A technique for performing diffusion-length measurements using a scanning electron microscope is described, and results of preliminary radiation effects studies on silicon employing this method are presented. (auth) (NTIS)

27268 (AD–734160) RADIATION EFFECTS RESEARCH PROGRAM. Annual Report, September 1, 1970–August 31, 1971. Grannemann, W. W.; Allen, R. C. Jr.; Boatwroght, L. T.; Byatt, W. J.; Southward, H. D. (New Mexico Univ., Albuquerque. Bureau of Engineering Research). Sep 1971. Contract N00014-68-A-0158. 173p. (EE–192(71); ONR–5)). NTIS.

The contents include radiation effects on GaAsP and GaP Schottky-barrier diodes; diffusion of Zn in GaAsP; Low-volume depletion region Schottky-barrier diodes; neutron and gamma radiation effects in GaAs laser diodes and bulk materials; MIS (Metal-Insulator-Semiconductor) studies; fabrication and testing of GaAsP MIS capacitors; thermal oxidation of GaAsP; electron-beam irradiation studies; magnetoresistance and radiation effects on electron-beam-evaporated high-mobility thin films of InSb; Hall effect in dielectric material; micro-Hall device studies; radiation effects on epitaxial silicon; semiconductor modeling study; electrons in disordered crystals; and application of invariant-imbedding methods to problems of transport theory and wave propagation. (auth) (NTIS)

27269 (AD–734210) ELECTRONIC AND RADIATION DAMAGE PROPERTIES OF RUTILE. Technical Report for Period Ending November 30, 1971. DeFord, John W.; Johnson, Owen W.; Rosenberger, Franz (Utah Univ., Salt Lake City. Dept. of Physics). 30 Nov 1971. 34p. NTIS.

Work was divided into the following areas: Crystal growth, dielectric loss, devices, Hall effect, radiation damage, theory and data analysis, optical absorption spectroscopy, photoconductivity and photoemission, review paper, and ultrasonic attenuation. (auth) (NTIS)

27270 (AERE-Bib–176) ION IMPLANTATION. A Bibliography. Morgan, R.; Greenhalgh, K. R. (Atomic Energy Research Establishment, Harwell (England)). Feb 1972. 94p. (HL–72/335). Dep. NTIS (U. S. Sales Only). UK 2 pound.

An attempt is made to cover all literature on ion implantation. Abstracts are given where the title is not self-explanatory, and indexes are provided. The abstracts are arranged under the following subject categories: General papers and reviews; machines and ion sources; physical measurements (including electrical and optical properties); chemical effects of ion implantation; lattice location of implanted ions; lattice disorder and radiation damage caused by ion implantation; range measurement and distribution of implanted ions; channeling behavior during ion implantation; and applications in the development of semiconductor devices. (Approximately 580 references). (UK)

27271 RADIATION EFFECTS ON THE DIELECTRIC PROPERTIES OF SOME FERRO-, ANTIFERRO-, AND PARAELECTRIC PEROVSKITES. Zakurkin, V. V.; Solov'ev, S. P.; Kuz'min, I. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 9, 1994-8(Sep 1971). (In Russian).

The dielectric constant ϵ was measured in a weak field for polycrystalline samples of $BaTiO_3$, $PbTiO_3$, $PbZrO_3$, $NaNbO_3$, and $SrTiO_3$ at room temperature during irradiation with 1.14- and 9.0-MeV electrons and with γ radiation from a ^{60}Co source. In addition, the Curie point behavior for monocrystalline $BaTiO_3$ and polycrystalline $PbZrO_3$ was investigated in a fast-neutron flux (>0.1 MeV) in the range 10^{17} to 10^{18} cm^{-2}. Values of ϵ for these substances dropped from 1 to 9% by exposure to the electron beam, depending on the identity of the salt and the nvt values, but could be restored to the original ϵ by annealing at 150°C. Similar results were noted for γ radiation. Neutron irradiation affected the samples but little, but post-irradiation heating produced as much as 10 to 30% increase in ϵ. (K.S.W.)

27272 CURRENT GENERATION IN BARIUM TITANATE UNDER THE INFLUENCE OF γ IRRADIATION. Panchenkov, G. M.; Pluzhnikov, V. M.; Kaushanskii, D. A.; Glazunov, B. P.; Avrorov, A. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 9, 1900-2(Sep 1971). (In Russian).

Gamma radiation produces an electric current in a polarized $BaTiO_3$ crystal in such a manner that the induced emf is proportional to the radiation level. Upon varying the temperature of the experiment between 5 and 150°C, a maximum emf was observed at 30 to 40°C, a minimum at 90°C, with the curve passing through null points at 60 and 130°C. A mechanism is proposed for this effect. (K.S.W.)

27273 X-RAY ANALYSIS OF IRRADIATED LEAD TITANATE. Solov'ev, S. P.; Dudarev, V. Ya.; Zakurkin, V. V.; Kuz'min, I. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 9, 1930-5(Sep 1971). (In Russian).

X-ray radiography was conducted on polycrystalline $PbTiO_3$ which had been subjected to fast neutrons with nvt $\approx 2 \times 10^{20}$ cm^{-2}, at a temperature of 40 to 70°C, and the change in lattice parameters was noted before and after annealing the samples at 300°C. The discussion compares the results with those of irradiating the simple oxides PbO and TiO_2 and radiation-stimulated diffusion in solids. (K.S.W.)

27274 RADIATION EFFECTS IN SODIUM TRIHYDROSELENITE. Peshikov, E. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 9, 1936-8(Sep 1971). (In Russian).

The effect of ^{60}Co gamma radiation at 60 to 70°C on the dielectric properties of sodium trihydroselenite was studied. Different degrees of deuteration of the compound were utilized (10 to 30%) in order to demonstrate a nonlinear lowering of the Curie point (upper phase transition), an alteration of the dielectric hysteresis loop, a decrease in spontaneous polarization, and an increase in the coercive field. (tr-auth)

27275 INFLUENCE OF STRUCTURAL DEFECTS THAT ARISE DURING γ AND REACTOR IRRADIATION ON THE PHASE TRANSITIONS AND DIELECTRIC PROPERTIES OF CRYSTALS OF POTASSIUM DIHYDROPHOSPHATE AND AMMONIUM DIHYDROPHOSPHATE. Peshikov, E. V.; Mukhtarova, N. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 9, 1939-42(Sep 1971). (In Russian).

The effects of large doses of ^{60}Co gamma radiation and of reactor radiation on the Curie point (T_c) of crystals of KH_2PO_4 and $NH_4H_2PO_4$ were investigated. The dielectric and structural characteristics of these crystals were also studied. The γ dose level was either 100 or 3,000 R/sec at 40 to 60°C; the fast-neutron flux was 5×10^{12} n · cm^{-2} · sec^{-1} (accompanied by 3.6×10^5 R cm^{-1} of γ

radiation) at a temperature of 60 to 70°C. The weakest structural element in these two phosphate salts proved to be the NH_4^- ion which was seriously disrupted by the radiations. (K.S.W.)

27276 DIELECTRIC LOSSES IN CRYSTALS OF TRIGLYCINE SULFATE WHEN SUBJECTED TO VARIOUS EFFECTS. Burdanina, N. A.; Zolototrubov, Yu. S.; Kamysheva, L. N.; Zhukov, O. K.; Kovalenko, A. N. (Voronezh State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 9, 1943-6(Sep 1971). (In Russian).

The effects of small doses of γ radiation from a ^{60}Co source (36 R/sec) and of x radiation were studied on $\epsilon(T)$ and tan $\delta(T)$ of triglycine sulfate. A sharp maximum in the ln tan δ vs T curve was noted at about 49°C, both before and after irradiation, but the effect of radiation was that of decreasing ln tan γ values at all temperatures; the latter values were partially restored after a 12-day storage of the sample. Similar temperature dependence of ϵ was found. (K.S.W.)

27277 SECONDARY ELECTRON EMISSION FROM ION-IMPLANTED SILICON. Konrad, G. T. (Massachusetts Inst. of Tech., Lexington). J. Appl. Phys.; 43: No. 4, 1996-8(Apr 1972).

A number of single-crystal p-type Si samples were implanted with Cs^+ ions to various concentrations and depths. The secondary electron emission coefficient δ of these samples was found to be as much as 28% higher than for untreated Si samples. In particular, the low value of primary voltage needed to obtain $\delta > 1$ suggests the use of such emitters in applications where secondary emission buildup at low primary voltages is desired. (auth)

27278 ELECTRON IRRADIATION DAMAGE IN SILICON CONTAINING HIGH CONCENTRATIONS OF BORON. Bean, A. R.; Morrison, S. R.; Newman, R. C.; Smith, R. S. (Univ. of Reading, Eng.). J. Phys., C (London); 5: No. 4, 379-400 (29 Feb 1972).

Silicon containing concentrations of up to 10^{20} atoms cm^{-3} of boron alone, or doubly doped with boron and a group-V donor impurity, were irradiated by 1.5- or 2-MeV electrons at 300°K. Infrared local-mode absorption measurements showed that this treatment can lead to the removal of a very large fraction of boron from unperturbed substitutional sites, and there is correlated growth of other local-mode bands. Certain bands were identified with a defect that appears to involve two boron atoms, while other bands are thought to arise from boron in interstitial sites. Annealing studies, involving both optical and electrical measurements, were consistent with this latter interpretation. The initial removal rate of boron from normal sites was very high and reached a limiting value of about 3 atoms cm^{-3} per electron cm^{-3} when the impurity concentration exceeded 10^{19} cm^{-3}. It is concluded that recombination of primary vacancies and intrinsic interstitials was almost completely inhibited in these samples. In the doubly doped crystals, it is suggested that the group V donors trapped the vacancies, while boron trapped the silicon interstitials. It is inferred that large vacancy clusters formed in samples containing only boron impurities. These results show that the large changes observed in the conductivity of degenerate p-type material may be interpreted as due to the removal of the acceptor impurities, and not necessarily to the formation of localized electronic levels near the band edges, as is commonly supposed. (auth)

27279 ELECTRON IRRADIATION DAMAGE IN ALUMINUM IN A HIGH-VOLTAGE ELECTRON MICROSCOPE. Shiraishi, Kensuke (Japan Atomic Energy Research Inst., Tokai); Hishinuma, Akimichi; Katano, Yoshio; Taoka, Tadami. J. Phys. Soc. Jap.; 32: No. 4, 964-71(Apr 1972).

Defect clusters are observed to form in aluminum during examination at about 20°C in a high-voltage electron microscope operating at 1000 kV with a beam current of 0.1 μA in a 5-μm diameter spot. As the electron dose increased, the clusters grow into resolvable dislocation loops. The defect clusters are identified as vacancy loops of Frank type. When the temperature is raised gradually to 70°C during electron irradiation, defect clusters grow into larger loops and eventually disappear with 70°C irradiation. Furthermore, no electron damage is observed in the specimen irradiated at 70°C without previous 20°C irradiation. In a quenched specimen, production rate of the defect clusters is larger compared with an annealed specimen and large quenched-in loops are found to shrink during 20°C irradiation. The damage rate is discussed in relation to nucleation and growth of the loops under vacancy supersaturated environment. (auth)

27280 INVESTIGATIONS OF ION IMPLANATATION IN SILICON USING PARTICLE CHANNELING. Hirvonen, James Karsten. New Brunswick, N. J.; Rutgers-The State Univ. (1971). 162p. University Microfilms Order No. 72-9628. Thesis.

Particle channeling was used to study the lattice disorder produced during ion implantation for heavy ions (Tl, Bi) as well as for a lighter ion (C). The lattice disorder for the 100- to 200-keV heavy ions was studied as a function of heavy-ion dose and energy. In addition, the post-implantation thermal annealing behavior of the heavy-ion disorder was compared to the disorder resulting from implantations carried out at an elevated temperature. The 150-keV carbon disorder was also studied as a function of dose and is seen to have a different behavior than the heavy-ion disorder. Additional differences in light and heavy ion disorder are seen by the use of the double-alignment channeling technique. These differences indicate a high degree of strain in the disordered region and allow an estimate of the displacements involved. They also indicate a fundamental difference in the local extent of light and heavy disorder. The lattice location of implanted Bi and Tl atoms was studied by particle channeling as a function of annealing temperature. The Bi shows a high substitutional component, whereas the Tl shows both substitutional and tetrahedral interstitial components whose ratio depends strongly on the annealing history of the sample. A room-temperature migration of the supersaturated interstitial Tl atoms is also seen. The depth distributions of channeled heavy (Bi, Sb, As) ions implanted into Si were measured by using Rutherford backscattering of 1- to 2-MeV He ions and 20-MeV O ions. Effects of the implantation energy and dose as well as the crystal orientation and temperature were investigated. The depth distributions consist of a shallow peak with an exponential tail extending to depths greater than ten times the range of unchanneled heavy ions. The sensitivity of the channeling probability and the dechanneling rate of aligned ions to the experimental variables is investigated by comparing the depth distributions to an analytical model function. (TSS) (Diss. Abstr. Int., B)

27281 EFFECT OF STRAIN DURING IRRADIATION ON THE ^{60}Co γ-RAY INDUCED F-CENTER COLORING OF KCl AT ROOM TEMPERATURE. Goldberg, Malcolm. Stony Brook, N. Y.; State Univ. of New York (1971). 194p. University Microfilms Order No. 72-6402. Thesis.

The absorption was monitored continuously throughout the experiment. Growth curves were recorded for crystals strained from 0.10 to 7.85% after first being colored well into the linear stage II. Strain less than 0.25% did not produce an increase in coloring, while strains beyond 0.25% increased the coloring. The equation for the F-center absorption as a function of irradiation time in $\alpha_F(t) = \Sigma_i A_i(1 - e^{-a_i t}) + \alpha_L t$ also characterizes the additional coloring found after strain. The data for unstrained KCl crystals require three saturating exponentials and a linear term. Only two exponentials and a linear term are required for the additional coloring induced after strains in excess of 0.25%. Auxiliary measurements indicated that these two post-strain components correspond to the slower two of the three saturating exponential components found to describe the coloring of unstrained KCl and are almost certainly caused by dislocation-related phenomena which are fundamental to the radiation-induced coloring of KCl. When the equation is fitted to the additional coloring induced after compression, the parameters in this equation are found to be explicit functions of the applied strain. A_i and α_L are linearly dependent on the square root of the deformation after yield, and A_2, a_1, and a_2 are linear functions of the deformation after yield. Using these dependences, one can write the equation in terms of the strain and obtain computed growth curves in reasonable agreement with the observed data. The linear and square root dependence on deformation of the observed strain-enhanced coloring is established and suggests well-known dislocation-related phenomena may be important in radiation coloring. The decrease in absorption following termination of irradiation was measured and resolved into three decaying exponential components and a stable component. The amplitude of the stable term was found to vary linearly with the square root of the deformation. The M-center absorption was also measured. After strain, the well-known relationship between M-Center and F-center absorption, $\alpha_M = K(\alpha_F)^2$ was found to hold only for stage II coloring. Plausible models, consistent with the observed results, are suggested. (TSS) (Diss. Abstr. Int., B)

27282 EFFECTS OF RADIATION DAMAGE ON THE ZERO-BIAS ANOMALY IN GALLIUM ARSENIDE SCHOTTKY-BARRIER TUNNEL JUNCTIONS. Mora, Nabih Assad. Providence; Brown Univ. (1971). 209p. University Microfilms Order No. 72-8175. Thesis.

The change of the zero-bias anomaly in Pb/GaAs (p-type) Schottky-barrier tunnel junctions caused by electron or neutron irradiations was investigated. The junctions, prepared by the vacuum deposition of Pb onto chemically polished p-GaAs single

crystals (Zn- or Cd-doped), were subjected to successive doses of either 10-MeV electron pulses or fast neutrons. In highly doped junctions with $p \sim 8 \times 10^{18}$ cm^{-3}, the zero-bias anomaly appeared as a 15% conductance dip at $T \leq 4.2$°K with a half-width of about 12 mV. A superimposed smaller and narrower (~1%, half-width ~ 1 mV) conductance peak, consistent with tunneling via localized magnetic states, was observed to disappear after light irradiation. Results indicate that the whole effect of both types of irradiations on the anomaly resulted solely from the reduction of the free carrier concentration through the trapping of carriers by defect states in GaAs. The defects themselves did not appear to contribute directly to the scattering of the tunneling electrons. That the free carrier density was the only factor affecting the anomaly was demonstrated by the fact that its dependence on the free carrier concentration was independent of whether the latter was attained by the irradiation or by initial doping. The free carrier concentration was determined from Hall-effect measurements. Some of the results can be explained by a model based on two-step resonant tunneling via intermediate states or small particles in the barrier. However, the experimental data is entirely consistent with the occurrence of a sharp minimum in the density of states at the Fermi energy due to localization of the carriers when their concentration approaches the Mott concentration N_c. According to the Hubbard model, this minimum develops into a gap below N_c. The observed increase in the line width below N_c is strong evidence of this gap. Smearing of the superconducting characteristics of Pb, which was observed when $p \sim N_c$, is evidence of lifetime broadening of the final states in the GaAs. The aforementioned experimental results suggest that tunneling can be used to study the density of final states in semiconductors in the Mott transition range. (TSS) (Diss. Abstr. Int., B)

27283 RECOMBINATION LUMINESCENCE IN IRRADIATED SILICON: EFFECTS OF THERMAL ANNEALING AND LITHIUM IMPURITY. Johnson, Eric Shanks. Urbana, Ill.; Univ. of Illinois (1971). 194p. University Microfilms Order No. 72-6967.

Thesis.

Silicon crystals irradiated with high-energy electrons at room temperature show two strong luminescence bands in the near infrared at low temperature. Both bands have a sharp zero-phonon peak followed by a series of broad phonon-assisted peaks. The effects of isochronal annealing and lithium impurity on the luminescence bands were determined. The higher-energy band associated with a zero-phonon peak at 0.97 eV in lithium-free silicon vanishes following an anneal at temperatures between 275 and 325°C, in agreement with the reported annealing of the divacancy. The impurity independence, stress splitting, and relative production rates are also consistent with this identification. The lower-energy band associated with a zero-phonon peak at 0.79 eV, seen only in oxygen-rich silicon, vanishes following an anneal at 500°C, in agreement with the reported annealing of the K center. A broad weak luminescence band is observed at 0.98 to 1.16 eV following a room-temperature anneal. It vanishes following an anneal near 150°C. New luminescence bands with profiles similar to the bands present after a room-temperature anneal grow in following an anneal above 300°C. Zero-phonon peaks associated with defects, which appear to depend on oxygen, are observed at 0.950, 0.925, and 0.767 eV. A new lithium-dependent band associated with a strong zero-phonon peak at 1.045 eV is observed in lithium-diffused oxygen-lean silicon irradiated at room temperature. The spectrum vanishes following an anneal near 400°C. The effects of lithium impurity in irradiated oxygen-rich silicon are less pronounced than in oxygen-lean silicon. The same zero-phonon peaks which are observed in lithium-free oxygen-rich silicon are seen; however, the intensity of the oxygen-dependent 0.79-eV spectrum identified with the K center is weak. The lithium-dependent band associated with the 1.045-eV zero-phonon peak is also seen at low intensity. The data are consistent with the formation of the LiO^+ ion, which ties up lithium and oxygen, and associates with vacancies. (TSS) (Diss. Abstr. Int., B)

27284 EPR SPECTRA OF IRRADIATED n-TYPE SILICON CARBIDE. Pavlov, N. M.; Iglitsyn, M. I.; Kosaganova, M. G.; Solomatin, V. N.; Barinov, Yu. V. Sov. Phys.-Solid State (Engl. Transl.); 13: No. 9, 2363-5(Mar 1972).

Translated from Fiz. Tverd. Tela; 13: No. 9, 2814-17(Sep 1971).

Crystals of hexagonal 6H SiC with nitrogen impurity were irradiated with either 25-MeV alpha particles or fast neutrons. The original EPR spectrum was destroyed by the irradiation, being replaced by a complex spectrum with a strong line (g factor = 2.0031) and numerous weak lines. Spin Hamiltonian parameters for eight defects were deduced from the spectra. The geometry of the defects, temperature effects, and fine structure of the spectra are discussed. (D.L.C.)

27285 DIFFERENTIAL SPUTTERING YIELD OF NiCu ALLOYS. Marignier, Jacques; Haymann, Pierre (Rouen Univ., Mont-Saint-Aignan, France). Compt. Rend., Ser. B; 274: No. 1, 81-4(3 Jan 1972). (In French).

The existence of preferential emission of one of the components of a solid NiCu solution was established for oblique incidences. The measurements were made on polycrystals and monocrystals, the region in the vicinity of the densely packed planes being considered for the latter. A 15-keV argon ion beam was used in the experiments. A law is proposed which takes into consideration the individual sputtering characteristics of each of the elements and postulates that the overall pulverisation S remains the same when they are alloyed. (France)

27286 ELECTRICAL AND ELECTRON MICROSCOPY OBSERVATIONS ON DEFECTS IN ION IMPLANTED SILICON. Matthews, M. D. (Atomic Energy Research Establishment, Harwell, Eng.). Radiat. Eff.; 11: No. 3-4, 167-78(Dec 1971).

The nature of damage present in ion-implanted silicon crystals was studied by transmission electron microscopy for a wide range of ion species (Ar, Xe, Pd, Au, Si, Ge at 40 to 100 keV) over the dose range 10^{13} to 10^{17} ions/cm^2 so that the marked dose dependence of defects after annealing (up to 900°C) and special impurity effects could be investigated. Electrical measurements (sheet resistivity and Hall effect) were made on antimony-doped p–n junction structures irradiated with nondoping ions to support these observations and determine some electrical effects of the damage. It was found that dislocation loop structures were evolved in the case of annealed low dose irradiations where there was only a small degree of overlap of adjacent disordered zones in the as-irradiated state. For irradiations that created a complete surface amorphous film, the damage remaining after 650°C anneals consisted of a complex dislocation array with microtwins, planar defects, and often some polycrystallinity following epitaxial regrowth of the surface. (auth)

27287 CONVERSION AND EQUILIBRIUM BETWEEN F AND F_2 CENTERS IN X-IRRADIATED KCl. II. DYNAMIC EQUILIBRIUM EXPERIMENTS. Seager, C. H.; Welch, D. O.; Royce, B. S. H. (Princeton Univ., N. J.). Phys. Status Solidi (b); 50: No. 1, 241-52(1 Mar 1972).

The temperature dependence of the dynamic equilibrium between F and F_2 centers was studied in KCl during x irradiation. Three distinct regions were identified: a high-temperature region corresponding in its temperature dependence of the equilibrium constant to the corresponding temperature range in additively colored crystals and two low-temperature regions in which the equilibrium constant increases with increasing temperature with an apparent activation energy of 0.25 and 0.85 eV. A kinetic model is developed to explain these observations which involves the random creation of point defects by the radiation, together with an enhanced creation probability near existing F centers. (auth)

27288 DISTRIBUTION IN PENETRATION DEPTH OF CHANNELED PARTICLES. Martynenko, Yu. V. Sov. Phys.-Solid State (Engl. Transl.); 13: No. 9, 2166-71(Mar 1972).

Translated from Fiz. Tverd. Tela; 13: No. 9, 2580-6(Sep 1971).

A kinetic equation for a beam of channeled ions in a crystal is derived with effects of changes in the energy of longitudinal and transverse ionic motion and the probability of dechanneling taken into account. The boundary condition for the distribution function at the crystal surfaces takes into account two-dimensional channeling. Solutions of the equation make it possible to calculate the profile of the ions penetrating a single crystal within a small angle of low-index direction. Results are given for 200-keV B ions in Si single crystals. (auth)

27289 EFFECT OF PROTON BOMBARDMENT ON $Pb_{0.76}Sn_{0.24}Te$. Tao, T. F. (Naval Postgraduate School, Monterey, Calif.); Wang, C. C.; Sunier, J. W. Appl. Phys. Lett.; 20: No. 7, 235-7(1 Apr 1972).

Effects of 200 to 450-keV proton bombardment on the electrical properties of $Pb_{0.76}Sn_{0.24}Te$ were studied. p-type samples of initial hole concentration in the low 10^{17}/cm^3 range were converted to n-type after a proton dose of 5×10^{13} p/cm^2. For samples of higher initial hole concentration, the conversion was less consistent. The change in mobility due to bombardment was found to be moderate. The mobilities of some p-type samples were doubled after type conversion. (auth)

27290 BEAM EFFECTS IN THE ANALYSIS OF As-DOPED SILICON BY CHANNELING MEASUREMENTS. Rimini, E.; Haskell, J.; Mayer, J. W. (California Inst. of Tech., Pasadena). Appl. Phys. Lett.; 20: No. 7, 237-9(1 Apr 1972).

Channeling-effect measurements with MeV He ions were used

to study the lattice location of As in silicon. Over the concentration range studied (5×10^{19} to $1.2 \times 10^{21}/cm^3$), As was found to be 90 to 95% on substitutional sites. However, it was found that bombardment with the analysis beam caused 20 to 40% of the As to move off lattice sites. This effect may be responsible for the relatively low As substitutional fraction found in previous investigations. No bombardment-induced off-lattice movement was found in Sb-doped Si, indicating that this movement is species-dependent. (auth)

27291 OBSERVATION OF DEFECT ANNEALING IN NEUTRON-IRRADIATED SILICON BY SPACE-CHARGE-LIMITED CURRENT. Magee, T. J.; Hermann, A. M.; Deck, R. J. (Tulane Univ., New Orleans). Phys. Rev., B; 5: No. 8, 3364-6(15 Apr 1972).

Space-charge-limited current (SCLC) was used to observe defect annealing in neutron-irradiated silicon. From the observation of the trap-filled-limit voltage, a deep-trap concentration in the irradiated unannealed crystals is found to be at least 1.4×10^{12} cm^{-3}. Shallow traps are also observed. This deep-trap concentration decreases with anneal temperature up to 200°C, above which SCLC can no longer be observed. There is evidence that at least some of this decrease is due to the conversion of the deep traps to shallow traps. (auth)

27292 LUMINESCENCE FROM COLOR CENTERS IN $KMgF_3$. Riley, C. R. (Oak Ridge National Lab., Tenn.); Yun, S. I.; Sibley, W. A. Phys. Rev., B; 5: No. 8, 3285-92(15 Apr 1972).

A study of the emission from electron- and γ-irradiated $KMgF_3$ crystals reveals bands at 407, 465, 590, 600, and 750 nm. By means of polarized bleaching experiments the bands at 465 and 590 nm can be assigned as due to F_3 and F_2 centers, respectively. In addition, the temperature dependence of both the widths and peak positions of the emission bands can be used to predict approximate values for the absorption energy of the defects responsible for these bands. The predicted absorption is very close to that observed for F_2 and F_3 centers. This lends further confidence to the assignments. The 600-nm emission is believed to be due to Mn^{2+} impurity ions. (auth)

27293 RADIATION ANNIHILATION OF F-AGGREGATE CENTERS IN KCl. Sonder, E. (Oak Ridge National Lab., Tenn.). Phys. Rev., B; 5: No. 8, 3259-69(15 Apr 1972).

The radiation annihilation of F-aggregate centers has been measured in KCl as a function of trace impurity and of temperature. The data have been found to support the idea that F-aggregate-center destruction occurs when a radiation-produced interstitial is trapped by an aggregate center. Comparison of the results with the F-center-production behavior of the same material has permitted the following conclusions about F-center production to be drawn: (i) The impurity dependence of F-center production at 80°K is due to a secondary process involving motion of interstitials. (ii) The large rise with temperature of the F-center-production efficiency between 120 and 240°K is a reflection of the temperature dependence of the primary defect-production mechanism and may be related to a change of the relative probabilities of Frenkel-pair separation and recombination during the production process. Analysis of the experimental results has also yielded values for the energy necessary to produce a Frenkel pair at various temperatures. Above 200°K this energy is so low [less than 100 eV/(defect pair)] that it is possible to rule out defect-production mechanisms that require multiple ionization. (auth)

27294 PHOTOLUMINESCENCE OF RADIATION DEFECTS IN ION-IMPLANTED 6H SiC. Patrick, Lyle; Choyke, W. J. (Westinghouse Research Labs., Pittsburgh). Phys. Rev., B; 5: No. 8, 3253-9(15 Apr 1972).

Radiation defects were introduced into 6H SiC by ion implantation and by electron bombardment. The defects produce a new low-temperature luminescence that is independent of the implanted ion, and one portion, the D_I spectrum, persists after a 1700°C anneal. A comparison of the D_I spectrum in ion- and electron-bombarded samples shows that its intensity is strongly dependent on defect concentration, suggesting that the luminescence center is a pure-defect complex, possibly a divacancy. The D_I spectrum, which was previously observed in cubic SiC, has a strong vibronic structure with localized and resonant modes. In 6H SiC it is repeated three times, due to the three inequivalent sites in this polytype. D_I has an unusual temperature dependence, the low-temperature (1.4°K) spectrum being extinguished as the high-temperature (77°K) form is activated. The abrupt change of spectrum is attributed to a lattice distortion at the low temperature. The changes in luminescence on annealing are correlated with changes in electrical properties observed in ion-implanted samples by Marsh and Dunlap. (auth)

Physical Properties

Refer also to abstracts 25533, 25955, 25965, 25973, 26061, and 26841.

27295 (BNL-16597) RELAXATION AND RENORMALIZATION OF SPIN WAVES IN EuO. Passell, L. (Brookhaven National Lab., Upton, N. Y.); Als-Nielsen, J.; Dietrich, O. W. (Danish Atomic Energy Commission, Risoe. Research Establishment). [1971]. 14p. (CONF-720304-3). Dep. NTIS.

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972).

Neutrons were used to study the dynamic behavior of EuO at temperatures extending up to the Curie temperature T_c and over a fairly wide range of wave vectors. Since the exact form of the scattering cross section is not known, only limited comparisons with the existing theory were possible. Dynamic scaling predictions of spin-wave renormalization appear to be qualitatively correct, but the observed line-width variations with wave vector and temperature are in only fair agreement with "hydrodynamic" predictions. As was the case with isotropic metallic ferromagnets, the EuO line shapes show no indication of a diffusive mode near T_c. (auth)

27296 (NP-19252) TABLES OF MAGNETIC STRUCTURES DETERMINED BY NEUTRON DIFFRACTION. SUPPLEMENT TO THE CUBIC SYSTEM. Oles, A.; Kajzar, F.; Kucab, M. (comps.) (Institute of Nuclear Techniques, Krakow (Poland)). Sep 1971. 62p. (INT-12). Dep. NTIS (U. S. Sales Only).

This supplement contains the compounds and alloys belonging to the cubic system at room temperature and omitted in the first edition. The tables contain the chemical formula, space group, crystallographic data, cation distribution, magnetic transition temperatures, magnetic structures and moments, and additional references. The compounds are arranged according to the space group, with a chemical formula index in the back. (290 references). (D.L.C.)

27297 (RT/EL-(71)3) PRELIMINARY RESEARCH ON ELECTRICAL CONDUCTIVITY IN THIN FILMS OF AMORPHOUS BORON. Caserta, G.; Nicolo, E.; Serra, A.; Torda, S. L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 7 Sep 1971. 29p. (In Italian). Dep. NTIS (U. S. Sales Only).

Preliminary results of electrical conduction measurements in amorphous boron thin films are reported. The current density–voltage curves display characteristics which are typical of Schottky conduction. An anomalous result is found concerning the Richardson's constant, which is exceedingly high. In order to tentatively explain this result, a very thin Schottky barrier is supposed to exist which may be crossed by a strong tunnel current. It is assumed that the Schottky barrier in the region of the contact betweeen the metal and boron film is very thin because of strong ionization of the traps in that region. The electron affinity of amorphous boron is calculated and found to be equal to 3.46 eV. (auth)

27298 DOMAIN STRUCTURE OF γ-IRRADIATED CRYSTALS OF TRIGLYCINE SULFATE. Yurin, V. A.; Belugina, N. V.; Meleshina, V. A.; Ankudinov, M. A.; Zheludev, I. S. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 9, 1927-30(Sep 1971). (In Russian).

Changes in the domain structure of triglycine sulfate crystals were induced by doses of ^{60}Co gamma radiation to 10 MR and were studied by selective etching of the domains. Changes in the hysteresis loop were also investigated as a function of radiation dose. (K.S.W.)

27299 CORE ANNIHILATION OF POSITRONS IN METALS. Shrivastava, S. B.; Shrivastava, B. D.; Dubey, V. S. (Vikram Univ., Ujjain, India). Physica; 58: No. 1, 140-3(1 Mar 1972).

Core-annihilation rates of positrons for a number of metals were calculated. The contribution of core electrons to the annihilation rate is found to decrease with the valency and increase with the atomic number. Some remarks are made about the nature of the annihilation process in ion cores. (auth)

27300 POSITRON DIFFUSION IN SOLIDS. Brandt, Werner (New York Univ., N. Y.); Paulin, Robert. Phys. Rev., B; 5: No. 7, 2430-5(1 Apr 1972).

Theoretical positron-lifetime spectra are derived for targets with structures such that positrons can diffuse into interstices where they remain trapped until, after a distinct lifetime, they annihilate with an electron into γ quanta. Exact expressions and convenient approximate formulas for different structural geometries are presented. The contribution of trapped positrons to

the angular correlation between the two annihilation γ quanta is derived. The propagation of errors in determining positron-diffusion constants or, conversely, parameters of the target microstructure from positron-annihilation characteristics is discussed. (auth)

27301 POSITRON ANNIHILATION IN SOLIDS. Singru, R. M. (Indian Inst. of Tech., Kanpur). pp 329-42 of Modern Aspects of Solid State Chemistry. /Rao, C. N. R. (ed.). New York; Plenum Publishing Corp. (1970).

A survey is presented of the processes involved in positron annihilation and of its use to study the physics and chemistry of solids. Methods of measuring angular distributions of the gamma rays and lifetimes are described, and results are given of lifetime measurements in gases; metals, semiconductors, and oxides; ionic crystals; and molecular materials. The chemistry of positronium is considered briefly. (39 references) (D.L.C.)

27302 TEMPERATURE DEPENDENCE OF THE SPIN–LATTICE INTERACTION FOR Gd^{3+} IN ThO_2 AND CeO_2. Oseroff, S. B.; Calvo, R. (Univ. Nacional de Cuyo, San Carlos de Bariloche, Argentina). Phys. Rev., B; 5: No. 7, 2474-80(1 Apr 1972).

The second- and fourth-order spin-lattice coefficients of Gd^{3+} in cubic positions of ThO_2 and CeO_2 crystals were measured as a function of temperature between 4 and 360°K by electron-paramagnetic-resonance experiments in uniaxially stressed crystals. The second-order coefficients are considerably different for the two crystals, and these coefficients show a large variation with temperature. A detailed theoretical calculation of these coefficients has not been carried out; however, it is possible to qualitatively interpret the observed temperature variation in terms of effects due to the modulation of the orbit–lattice interaction by the lattice vibrations. The temperature-variation curves are explained using an Einstein model for the vibrations of the oxygen ligands of the paramagnetic ions. The fourth-order coefficients are similar for the two crystals and are temperature independent in the range studied. The effect of a hydrostatic strain on the energy levels of the ion is used to explain the observed temperature variation of the cubic field parameter in terms of the thermal expansion of the crystal. (auth)

27303 STATIC AND DYNAMIC EFFECTS OF THE MAGNETOELASTIC INTERACTION IN TERBIUM AND DYSPROSIUM METALS. Vigren, D. T.; Liu, S. H. (Iowa State Univ., Ames). Phys. Rev., B; 5: No. 7, 2719-34(1 Apr 1972).

A detailed theoretical study has been made of the magnetoelastic perturbation of the spectra of elementary spin and lattice excitations in Tb and Dy metals. The theory was formulated on the basis of an interaction formed from bilinear products of local spin and strain functions. Previous ad hoc models appear in certain limits of the theory, giving a coherence to the theoretical picture of magnetoelastic coupling. It is found that uniform magnetostriction causes a smooth transition from "free-lattice" to "frozen-lattice" perturbation of the magnon spectrum depending on the wave vector of the state. The microwave absorption versus magnetic field applied along the hard planar axis of Tb and Dy is calculated. It is found that free-lattice magnons are primarily responsible for low-frequency absorption in Tb below 140°K, and for both low- and high-frequency absorption in Dy below the Curie temperature of that metal. It is shown that the transition from free- to frozen-lattice behavior of the magnon spectrum is essential to the explanation of existing data on the temperature dependence of absorption-peak positions in Tb. The dynamic interaction between spin and lattice waves is derived and used to calculate the mixed-mode splittings in regions of the Brillouin zone of Tb where phonon and magnon dispersion curves cross. The theory predicts well the splitting which occurs where the acoustical-magnon and phonon branches touch, but fails to account for the splitting between the acoustical-magnon and optical-phonon branches. A different coupling mechanism is proposed which may account for the mixing of these branches. (auth)

27304 THERMALLY EXCITED CONFIGURATIONS OF LOCAL MOMENTS: TRANSITIONAL IMPURITIES IN SIMPLE METALS. Peters, James John. Urbana, Ill.; Univ. of Illinois (1971). 135p. University Microfilms Order No. 72-7030.

Thesis.

Susceptibilities are reported as a function of temperature of the 3d transitional elements, V, Cr, Mn, Fe, Co, and Ni in liquid solvents formed from Cu, Zn, Ga, As, and mixtures of these elements. The susceptibilities vary systematically with e/a. These and other data available in the literature are analyzed using a simple quasi-atomic model in which the impurity spin Hamiltonian includes a term which is written as an even function of the impurity total spin operator to treat the region of spin near zero. The model represents spin fluctuations near the Hartree–Fock instability by a thermal distribution of localized excited impurity spin configurations. It gives a coherent account of the available data concerning local moments at elevated temperatures and allows the role of solvent properties in local moment creation to be distinguished from specific impurity properties related to the excitation energies. (Diss. Abstr. Int., B)

27305 ELECTRICAL AND MAGNETIC PROPERTIES OF PARAMAGNETIC VANADIUM–IRON ALLOYS. Nellis, W. J.; Brodsky, M. B. (Argonne National Lab., Ill.). J. Appl. Phys.; 43: No. 4, 1961-5(Apr 1972).

The low-temperature electrical resistivities, magnetoresistances, and magnetic susceptibilities of VFe alloys were measured in the range 18 to 28% iron, the range in which VFe undergoes a transition from Pauli paramagnetism to ferromagnetism. The measurements were repeated after plastic deformation to determine the effects of short-range atomic order on the CsCl-like crystal structure of these alloys. The onset of a magnetic scattering mechanism is observed at 22% iron by the appearance of minima in the resistivity–temperature curves, by an increase in ($d\rho/dc$), and by a negative magnetoresistance. The field dependences of the susceptibilities indicate interactions between ferromagnetic clusters. The electrical properties are interpreted in terms of spin-flip scattering from ferromagnetic clusters. The increases in magnetic susceptibility and in the magnitude of the negative magnetoresistance with plastic deformation are interpreted in terms of a defect structure which increases the number of iron–iron nearest neighbors. The data for V(24% Fe) yield an estimated average cluster moment of 40 μ_B and an effective cluster concentration of 0.01%. (auth)

27306 STRUCTURE AND COMPOSITION OF SPUTTERED TANTALUM THIN FILMS ON SILICON STUDIED BY NUCLEAR AND X-RAY ANALYSIS. Croset, M.; Velasco, G. (Thomson-CSF, Orsay, France). J. Appl. Phys.; 43: No. 4, 1444-8(Apr 1972).

Microanalysis by direct observation of nuclear reactions and by backscattering of He^+ ions was used to determine the composition of sputtered Ta films on silicon. Oxygen and nitrogen concentration as low as 0.3 and 0.1%, respectively, were found for bcc and β-Ta structures. At a low deposit rate, oxygen incorporation in β-Ta structure up to about 20% was observed and correlated to a resistivity increase. The Ar/Ta ratio varies between 1.5 and 3% with increasing sputtering power. (auth)

27307 VARIATION WITH DEPTH OF THE ELECTRICAL PROPERTIES OF SPUTTERED TANTALUM FILMS. Waterhouse, Neil (Bell-Northern Research, Ottawa). J. Appl. Phys.; 43: No. 4, 1498-1504(Apr 1972).

The variation of the electrical properties with depth in the film was measured for two sputtered tantalum films using anodization by stages in a citric-acid electrolyte as a method of sectioning the films. Changes in the temperature dependence of the resistivity, between ~20 and 300°K, and in the room-temperature Hall coefficients with film thickness were measured. A dual conduction model for sputtered tantalum films was used to assist in analyzing the measurements. The resistivities of the tantalum layers were calculated from simple parallel-resistor theory, and the functional forms of the ρ-vs-T curves of these layers were closely predicted by this model. The trends of these curves with film depth were accounted for by simply changing the relative "weighting" of the model's two conduction mechanisms. (auth)

27308 X-RAY EMISSION SPECTRA IN THE SYSTEM Zr–C–O. Rue, James Wilson. Seattle; Univ. of Washington (1971). 145p. University Microfilms Order No. 72-7413.

Thesis.

The x-ray emission spectrum of a group of compositions in the Zr–C–O system was measured. In order to measure emission spectra, major design changes were conceived and incorporated into a standard vacuum spectrometer so that operation in the ultrasoft x-ray region was possible. Shifts in peak intensity and structural features of the intensity distribution were correlated with the previously measured spectra of ZrC and other transition metal compounds. This correlation was based on simple electronic structures that were constructed from reliable electron spectroscopic and emission data. Certain features in x-ray emission data reported previous to this study could be identified or confirmed based on the re-evaluated electron spectroscopic and x-ray emission data. A comparison of the x-ray emission spectra of the oxycarbides studied indicated that oxygen behaves in the same manner as carbon in ZrC_xO_y. This result was based on the trend in the core level shifts in zirconium and the O 1s level shift in oxygen. The O 1s level shift is supported by a crossover

transition identified as a C 2p → O 1s crossover transition. (Diss. Abstr. Int., B)

27309 STRUCTURE AND ELECTRICAL PROPERTIES OF Ta FILMS SPUTTERED IN Ar–O_2. Feinstein, L. G.; Gerstenberg, D. (Bell Telephone Labs., Inc., Allentown, Pa.). Thin Solid Films; 10: No. 1, 79-89(Apr 1972).

The effect of varying oxygen content upon structural and electrical properties of Ta films was investigated. The 2000-Å films were deposited by dc diode sputtering at 6.6 kV and 300 mA onto Corning 7059 glass, quartz, sapphire, and Ta_2O_5 coated Corning 7059 glass substrates. Crystalline structure of the Ta deposits was studied by an x-ray film technique, and their oxygen contents were determined with an electron microprobe. The β-Ta phase is obtained for films containing no oxygen. Solubility of O_2 in the β-phase is about 5 at. %, after which a phase related to TaO_2 appears. At 13 at. % O_2, bcc-Ta diffraction lines appear and grow in intensity with increasing O_2 content as the amounts of the first two phases decrease. The three-phase region extends up to 28 at. % O_2. At 30 at. % O_2, only bcc-Ta remains, indicating a solubility much higher than that reported for the bulk phase. Resistivities increased from 180 $\mu\Omega$ cm for β-Ta to 350 $\mu\Omega$ cm at 30 at. % O_2. In addition, temperature coefficient of resistance and themoelectric power were determined as a function of oxygen content. (auth)

27310 VARIATION OF THE INTERATOMIC DISTANCE OF GADOLINIUM AND YTTERBIUM AS A FUNCTION OF THE GRAIN SIZE. Vergand, F.; Bonnelle, C. (Univ., Paris). Solid State Commun.; 10: No. 5, 397-400(1 Mar 1972). (In French).

A decrease in the interatomic distance for very thin films of gadolinium and ytterbium was observed and is discussed in terms of the grain size and the surface tension. The different behavior revealed for these two elements can be related to their electronic properties. (auth)

27311 X-RAY ANALYSIS OF SPUTTERED FILMS OF BETA-TANTALUM AND BODY-CENTERED CUBIC TANTALUM. Read, Mildred H. (Bell Telephone Labs., Inc., Murray Hill, N. J.); Hensler, D. H. Thin Solid Films; 10: No. 1, 123-35(Apr 1972).

The x-ray diffraction patterns obtained from thin films of β-Ta and bcc-Ta are complicated by variations in type and degree of preferred orientation, and by variations in cell parameters. A discussion of the effects of these variations on the modified Debye–Scherrer x-ray diffraction patterns is given. The diffraction patterns from the commonly observed (200) β-Ta and (110) and (111) bcc-Ta preferred orientations are illustrated, as well as those from mixtures of the two phases. For the case in which the film is a mixture of β-Ta and bcc-Ta phases, it is shown that the unit cells of the two phases expand in parallel. The difficulty in determining the orientation and relative amount of a phase present in a film containing both phases on the basis of diffractometer traces alone is emphasized. (auth)

27312 ANOMALOUS-SHEAR ULTRASONIC ATTENUATION PEAK BETWEEN T_N AND T_c IN Ho. Lee, M. C.; Treder, R. A.; Levy, M. (Univ. of Wisconsin, Milwaukee). Phys. Lett.; 38A: No. 7, 499-500(27 Mar 1972).

An anomalous attenuation peak of about 90°K was observed for shear sound waves transmitted along the c-axis of two holmium single crystals. (auth)

27313 NEUTRON DEPOLARIZATION MEASUREMENTS ON A Dy SINGLE CYRSTAL. Rauch, H.; Zeilinger, A. (Oesterreichische Hochschule, Vienna). Atomkernenergie; 19: No. 2, 167-70(Apr 1972).

The depolarization of polarized thermal neutrons by transmission through a Dy single crystal near the Curie point was measured in order to obtain information about the micromagnetic structure of this substance. The magnetic phase transition observed is sharper than for polycrystals, but a marked broadening and hysteresis of the transition is measured for the single crystal, too. The results demonstrate a strong relaxation effect for the micromagnetic structure near the transition line with time constants in the order of 30 min. It is assumed that the hysteresis and magnetic aftereffect are associated with the lattice clamping effect and the strong magnetostriction of this substance. (auth)

27314 CRYSTAL STRUCTURE OF $LaErO_3$ AND $LaLuO_3$. Mueller-Buschbaum, Hk.; Graebner, P.-H. (Univ., Kiel). Z. Anorg. Allg. Chem.; 386: No. 2, 158-62(Dec 1971). (In German).

Single crystals of $LaErO_3$ and $LaLuO_3$ were prepared at temperatures above 2000°C. Single-crystal diffraction data result in an orthorhombically distorted perovskite structure. $LaErO_3$: a = 6.07, b = 5.85, c = 8.45 Å; $LaLuO_3$: a = 6.00, b = 5.795, c = 8.35 Å. (auth)

27315 EFFECT OF SUBSTRUCTURE ON PLASTIC DEFORMATION OF HIGH-PURITY NIOBIUM SINGLE CRYSTALS. Raghuram, Agrahar Chowdappa. Providence; Brown Univ. (1971). 159p. University Microfilms Order No. 72-8165.

Thesis.

The deformation properties and imperfection structure were studied for high-purity niobium single crystals produced by electron-beam float-zone refining. These crystals contained low-angle dislocation subboundaries whose spacings and misorientations depended on the crystal growth conditions. The spacing between subboundaries and their individual misorientations decreased as the solidification rate increased. Microhardness measurements on the subgrain boundaries gave a positive indication that the hardness at these boundaries was higher than that of the subgrain interiors, even in this relatively pure niobium material. The exceptional hardness of the subboundaries is comparable to that which exists at grain boundaries in less pure niobium material. The excess hardness disappeared on annealing, thus indicating that a redistribution of interstitial impurity atoms occurred from their segregated state at the boundaries in the as-grown crystals. The stress–strain behavior of different compression cylinders was determined for various aspect ratios by changing the height of the specimens. A new superimposed Laue technique was developed to study the glide rotations. An aspect ratio of 2.5 was judged to be favorable for observing a well-defined stress–strain curve. Resolved shear strength levels of 1.0 to 5.0 kg/mm^2 were measured for the crystals according to their solidification history. It is proposed that the subgrain boundaries act as obstacles to slip bands, especially because of the segregation of solute to these boundaries. On this thesis, the critical resolved shear stress τ_{CRSS}, is shown to be related in this study to the subgrain size, l_s, by a Hall Petch relation $\tau_{CRSS} = \tau_0 + k_s l_s^{-\frac{1}{2}}$, where τ_0 and k_s are constants. The hardness and stress–strain results on these crystals are compared with polycrystal results on niobium and with other results showing the influence of substructure on the strength of materials. (Diss. Abstr. Int., B)

27316 LOW-TEMPERATURE HEAT CAPACITY OF METALS. Phillips, Norman E. (Univ. of California, Berkeley. Technical Univ. of Helsinki, Otaniemi, Finland). CRC Crit. Rev. Solid State Sci.; 2: No. 4, 467-553(Dec 1971).

Selected topics on the low-temperature heat capacities of metals are reviewed. The heat capacity of dilute alloys of transition metals in nonmagnetic hosts is emphasized. Other topics considered include lattice heat capacities and a comparison of calorimetric and elastic constants data, the electronic heat capacity of nontransition metals, the heat capacity of superconductors, and hyperfine heat capacities. A bibliography of measurements on metallic elements and selected values of their electronic heat capacities and Debye temperatures are included. (503 references). (auth)

27317 ELECTRONIC PROPERTIES OF A THIN GERMANIUM LAYER ADSORBED ON A TUNGSTEN SURFACE. Clark, Howard Evans. Washington, D. C.; American Univ. (1971). 103p. University Microfilms Order No. 72-10,315.

Thesis.

A field-emission microscope with retarding potential energy analyzer was used to study Ge adsorption on W tips. The arrival of single atoms was detected. Total field-emission current is found to decrease as Ge is added, reaching a minimum at monolayer coverage. Further addition of Ge causes the current to increase until at about two monolayers it is again equal to its initial value. Fowler–Nordheim data indicate that this behavior may be interpreted according to the classical picture of work function change. Measurements of the total energy distribution for field-emitted electrons reveal that the atomic energy levels of the Ge adatoms are shifted upward and broadened by about 1.25 eV for atoms in the first layer and 0.4 eV for atoms in the second layer. A model density of states function is proposed to account for the observed energy distribution shapes. Resonant energy levels appear to be derived from the $4p^2\ ^1S$ state for first-layer atoms and from the $5s\ ^1P$ and/or ^3P states for second-layer atoms. Excellent agreement is found between measured total energy distribution curves and the recent calculations of Nicolaou and Modinos for triple germanium layers. No evidence was found for emission from surface states or from the adsorbate conduction band. An extremely stable Ge–W surface alloy was found whose total energy distribution (and effective density of states) is quite different from that of clean W. (Diss. Abstr. Int., B)

27318 ULTRASONIC SOUND PROPAGATION NEAR MAGNETIC PHASE TRANSITIONS. Moran, Thomas Joseph Jr. New Brunswick, N. J.; Rutgers–The State Univ. (1971). 158p. University Microfilms Order No. 72-9652.

Thesis.

Measurements of the critical changes in sound velocity near the second-order magnetic phase transitions in Gd, Tb, Dy, Ho, $RbMnF_3$, and MnF_2 were performed. In addition, high-frequency attenuation measurements were performed in $RbMnF_3$, MnF_2, and EuO. The critical velocity changes in the rare earths were found to be proportional to $-\omega^2 C$ (logarithmic temperature dependence), where C is the magnetic part of the specific heat, in the paramagnetic state, in agreement with theory. Values of the spin fluctuation relaxation time, τ, were obtained. Additional studies of the magnetic-field dependence of the sound velocity in the rare earths were made. A detailed study of the ultrasonic sound propagation was made in $RbMnF_3$ for (100) and (111) propagation directions. Critical changes in sound velocity were measured at frequencies up to 150 MHz and found to be isotropic. Deviations from $-\omega^2 C$ behavior were found at the higher frequencies. The critical attenuation was measured over a frequency range of 90 to 930 MHz and found to be proportional to the theoretical result, $(\omega\tau_L)^2/(1+\omega^2\tau_L^2)$, where τ_L is the spin–lattice relaxation time and is proportional to C. It was found 2×10^{-10} sec $\leq \tau_L \leq 3.5 \times 10^{-10}$ sec for $2.4 \times 10^{-2} \geq \epsilon \geq 3.6 \times 10^{-4}$, where $\epsilon = (T - T_N)/T_N$. The relaxation time was found to be isotropic and the values of τ_L obtained from the above formula agreed with those from a combination of low-frequency attenuation and velocity data and from the velocity dispersion. Theoretical values of τ_L were found to agree quite well with the values. The critical velocity and attenuation extrema were found to shift to lower temperatures with increasing frequency. The low-frequency sound velocity in the ordered region for (111) propagation was found to be proportional to $-(A\epsilon^{0.3\pm0.1} + B)$; i.e., nondivergent as is the specific heat for $T < T_N$. Significant velocity dispersion was found in MnF_2 for frequencies up to 110 MHz. At 90 and 110 MHz, the critical anomaly was almost entirely suppressed and a maximum was found at T_N. A constant $\tau_L = (2.7 \pm 0.2) \times 10^{-9}$ sec was found for $4 \times 10^{-2} \geq \epsilon \geq 8 \times 10^{-4}$. τ was found to increase for smaller values of ϵ and at $\epsilon = 1.5 \times 10^{-4}$, $\tau = (4.0 \pm 0.2) \times 10^{-9}$ sec. It is suggested that the increase is due to an additional coupling to the spin fluctuations, the mechanism which dominates in the rare earths. Attenuation was studied in EuO up to 575 MHz, and no critical effects were found. The lack of an anomaly is explained by limiting the coupling to the spin energy density. Additional attenuation peaks were found in $RbMnF_3$ for $T < T_N$ which shifted to lower temperatures with increasing frequency. Similar effects, which had been mistaken for a shift in the critical attenuation peak, were found in MnF_2. Possible explanations for these effects are given. (TSS) (Diss. Abstr. Int., B)

27319 DIELECTRIC LOSSES IN ANODIC Ta_2O_5 FILMS. Wilcox, P. (Bell-Northern Research, Ottawa). J. Vac. Sci. Technol.; 9: No. 1, 74-8(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

The dielectric loss behavior of the anodic oxide on sputtered tantalum films and a model that describes this behavior are discussed. The oxides exhibit a tan δ that varies relatively slowly with temperature at low temperatures but shows a rapid increase at temperatures somewhat above room temperature. The loss value decreases with increasing oxide thickness, approaching a constant value above approximately 2000 Å. Low-frequency loss values were obtained using the step-response technique, and a nonlinear response at high applied fields was observed. The time dependence of the step response currents was similar for low and high applied fields. A model based on the exchange of electrons between metal electrodes and trapping states in the oxide adequately describes these results. Mono-energetic traps can result in a distribution of relaxation times because to the tunneling electron the traps present an effective cross section which decreases exponentially with distance from the interface. The model predicts an inverse dependence of tan δ on oxide thickness. Traps distributed uniformly in space and exponentially in energy result in a temperature-dependent tan δ that closely fits the experimental results. A nonlinear response at high fields is also predicted by the model. (auth)

27320 ELECTRICAL PROPERTIES OF SPUTTERED Au/Ta_2O_5 CERMET THIN FILMS. Sashital, S. R.; Pakswer, S. (Zenith Radio Corp., Chicago). J. Vac. Sci. Technol.; 9: No. 1, 78-82 (Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

Thin film cermets of Au–Ta_2O_5 were deposited by rf co-sputtering, using two different methods, on glass substrates. In the first method, a single target of Ta_2O_5 covered partially with Au was used. The second method utilized the sputtering of Au, in the form of a mesh placed in the plasma of an rf discharge between the Ta_2O_5 target and the substrate. The composition of the cermets investigated varied from 11 to 52% by weight Ta_2O_5. The resistivity varied from 6×10^{-5} to 32 $\Omega \cdot$ cm with the corresponding TCR's from +1700 to −2000 ppM/°C. Resistivities were measured in the temperature range −180 to 160°C. Plots of log ρ vs T^{-1} for negative TCR films show the occurrence of three different activation energies for the conduction process: a low activation energy for $T < 133$°K, intermediate activation energy for $133°K < T < \sim 253$°K, and a high activation energy for $T > 253$°K approximately. Good correlations between resistivity, TCR, activation energy, and composition are observed. Resistivity is seen to correlate well with TCR. (auth)

27321 CHANGES IN THE rf CONDUCTIVITY OF DISCONTINUOUS MOLYBDENUM FILMS EXPOSED TO OXYGEN. Deshpande, S. M.; Crowell, A. D. (Univ. of Vermont, Burlington). J. Vac. Sci. Technol.; 9: No. 1, 97-100(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

The frequency-dependent electrical resistance of discontinuous (i.e., ultrathin, < 100-Å thick) metal films can be interpreted in terms of a simple equivalent circuit with frequency-independent parameters whose values can be obtained by a computer analysis of the film resistance as a function of frequency in the megahertz range. The equivalent circuit is composed of a resistance R_b, associated with conduction in the film grains, and a resistance R_g in parallel with a capacitance C_g, associated with conduction across intergranular gaps. By observing changes in these quantities for evaporated Mo films exposed to O_2 in situ, it has been possible to differentiate the effects of this gas on the bulk conductivity in the grains from its effects on intergranular conductivity. Upon exposure to O_2 at 10^{-7} to 10^{-4} torr and room temperature (~22°C), Mo films showed a more rapid increase in R_b than R_g during initial stages of chemisorption and oxidation, and vice versa as oxidation proceeded, showing that the changes in conductivity of these films produced by the interaction with gas molecules depend upon the location of the molecules within the film. (auth)

27322 PARALLEL BETWEEN SURFACE STATES AT THE Si/SiO_2 INTERFACE AND THE B_2 CENTER IN IRRADIATED SiO_2. Hickmott, T. W. (IBM Watson Research Center, Yorktown Heights, N. Y.). J. Vac. Sci. Technol.; 9: No. 1, 311-15(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

The effect of annealing in nitrogen and hydrogen atmospheres on surface-state densities N_{ss} at the Si/SiO_2 interface has been measured using the linear voltage-ramp method which gives N_{ss} vs silicon surface potential. A mercury probe was used in order to eliminate the effect of aluminum on surface-state reduction. The dependence of annealing of surface states on atmosphere and temperature closely parallels that of the B_2 center in sputtered SiO_2, an absorption center with maximum absorption at 5.1 eV which is observed in irradiated SiO_2. In N_2, temperatures between 700 and 800°C are required to anneal completely the B_2 center; N_{ss} reaches its lowest values after annealing in N_2 at 700°C. In H_2, the B_2 center anneals completely and N_{ss} is reduced to its lowest values after heating at 400°C. Annealing at 600 or 700°C in H_2 increases N_{ss} and introduces a surface-state level ~0.1 V above the midgap energy E_i. (auth)

27323 ORDER–DISORDER TRANSITION IN $VD_{0.8}$. Chervyakov, A. Yu.; Entin, I. R.; Somenkov, V. A.; Shil'shtein, S. Sh.; Chertkov, A. A. Sov. Phys.-Solid State (Engl. Transl.); 13: No. 9, 2172-7(Mar 1972).

Translated from Fiz. Tverd. Tela; 13: No. 9, 2587-94(Sep 1971).

A neutron-diffraction study of single crystals and polycrystalline aggregates of $VD_{0.8}$ was made. It was established that, in the disordered state, the deuterium atoms are statistically distributed in the tetrahedral interstices of the metal lattice, but a certain proportion (~10%) also occupies the octahedral interstices. At the order–disorder transition (T = 208°K) the double sublattice occupation of the interstitial positions is retained, and the deuterium atoms become ordered in both the tetrahedral and octahedral sublattices. The structure of the ordered phase of $VD_{0.8}$ is similar to that of the ordered phases of $TaD_{0.87}$ and $NbD_{0.95}$. (auth)

27324 ABNORMAL PHASE TRANSITION IN THE VANADIUM DEUTERIDE, V_2D. Somenkov, V. A.; Entin, I. R.; Chervyakov, A. Yu.; Shil'shtein, S. Sh.; Chertkov, A. A. Sov. Phys.-Solid State (Engl. Transl.); 13: No. 9, 2178-82(Mar 1972).

Translated from Fiz. Tverd. Tela; 13: No. 9, 2595-2600(Sep 1971).

It was established by neutron-diffraction studies that an order–disorder transition occurs at room temperature in the vanadium deuteride, V_2D. In the disordered state the deuterium atoms are located mainly in the tetrahedral interstices of the body-centered cubic metal lattice and only a small proportion (10% of the total) are in the octahedral interstices. The ordering is accompanied by the transition of deuterium atoms into octahedral and tetrahedral

interstices of a specific type (with a single direction of the axis of tetragonality) while the filling of the tetrahedral and octahedral sublattice by interstitial atoms changes in character. In the ordered state, ~95% of the deuterium atoms are located in the octahedral interstices. The possible causes of the transition of the interstitial atoms from one sublattice to another during the ordering process are examined. (auth)

27325 PARAMAGNETIC PROPERTIES OF ALLOYS OF THE $Be_2Mn_{1-x}Fe_x$ SYSTEM. Jesser, Roland (Univ., Strasbourg). Compt. Rend., Ser. B; 274: No. 1, 12-15(3 Jan 1972). (In French).

The paramagnetic susceptibilities of alloys of the $Be_2Mn_{1-x}Fe_x$ system measured between 100 and 1100°K may be represented by a Curie–Weiss law corrected with constant terms. From the Curie–Weiss constants thus obtained, the variation in the average effective number of carriers per atom was deduced for the transition metal. (France)

27326 CRYSTALLINE STRUCTURE OF V_8C_7. Guerin, Y.; de Novion, C. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Rev. Int. Hautes Temp. Refract.; 8: No. 3-4, 311-14 (Jul 1971). (In French).

Debye–Scherrer x-ray analysis was used to specify the positions of V atoms in the carbide, V_8C_7. This carbide is an ordered superstructure of the substoichiometric, $VC_{0.88}$. The V atoms, which are immediately adjacent to C voids, are separated from these voids by a distance of 0.14 Å. The other distance parameters are also calculated. A confidence factor, R = 4.14%, is obtained for the structure factors, taking into account an isotropic Debye–Waller parameter, which for C and V is equal to 0.35 Å^2. The superstructure lines are more intense than those obtained by other workers; this fact is linked to small differences in stoichiometry. (France)

27327 CORRELATIONS OF THE WORK FUNCTIONS OF TRANSITION METAL CARBIDES IN THE HOMOGENEITY REGION WITH THE SURFACE RECOMBINATION OF HYDROGEN ATOMS. Fomenko, W. S.; Lavrenko, W. A.; Ochremtschuk, L. N.; (and others). Rev. Int. Hautes Temp. Refract.; 8: No. 3-4, 315-8(Jul 1971). (In German).

The work functions corresponding to Ti and Nb carbides were investigated as a function of temperature. Numerical values for the surface recombination coefficients of the hydrogen were obtained for these compounds and also for stoichiometric Zr, V, Ta, Cr, and W carbides. The relations existing between the different properties studied are demonstrated. A model of the electronic structure of the carbides of the transition metals is proposed to explain the results obtained. (France)

27328 INFLUENCE OF DOPING ON SOME PHYSICAL PROPERTIES OF GRAPHITE. Tamarin, P. V.; Batdolov, A. B.; Volga, V. I. (Inst. of Semiconductors, Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 13: No. 9, 2368-9(Mar 1972).

Translated from Fiz. Tverd. Tela; 13: No. 9, 2819-21(Sep 1971).

An investigation was conducted of the electric conductivity, thermal conductivity, and thermoelectric power of pyrolytic graphite before and after annealing and doping with 7.5% Zr + 2.5% Si or 0.01 to 3% B. The temperature range extended down to 2°K. (D.L.C.)

27329 TEMPERATURE DEPENDENCE OF THE ELECTRIC RESISTANCE OF Mn_3B_4. Novogrudskii, V. N.; Timoshchuk, V. I.; Fakidov, I. G. (Inst. of Metal Physics, Sverdlovsk, USSR). Sov. Phys.-Solid State (Engl. Transl.); 13: No. 9, 2372-3(Mar 1972).

Translated from Fiz. Tverd. Tela; 13: No. 9, 2823-4(Sep 1971).

In order to understand the magnetic transitions at −59 and +140°C, the electric resistance of Mn_3B_4 was measured at −190 to +170°C. A plot is included of the temperature dependences of both the resistivity and susceptibility. Metallic behavior is observed, with no singular change near the Néel point (140°C) but a definite kink near −59°C, indicating a considerable change in the conduction–electron behavior and carrier spectrum as well as in the magnetic order. (D.L.C.)

27330 INTERACTION OF OXYGEN WITH THE (0001) FACE OF RHENIUM. Gorodetskii, D. A.; Knysh, A. N. (Kiev State Univ.). Sov. Phys.-Solid State (Engl. Transl.); 13: No. 9, 2119-23(Mar 1972).

Translated from Fiz. Tverd. Tela; 13: No. 9, 2521-6(Sep 1971).

The interaction of oxygen with the (0001) face of rhenium was studied by slow electron diffraction, the work function of the surface being determined at the same time. The adsorption of oxygen by a substrate at room temperature raises the work function by 0.9 eV and yields a diffraction pattern corresponding to the (2 × 2) structure. Heating the adsorbed layers to 300°C reduces the work function and increases the intensity of the additional reflections. The changes taking place in the work function of the film–substrate system, the surface structure, and the intensity of the reflections are compared over a wide temperature range for various degrees of coverage. The formation of the (2 × 2) structure involves the penetration of oxygen atoms into the surface layer of the rhenium and the reconstruction of the latter. (auth)

27331 FOSSILIZATION OF ELECTRICAL CORONA STREAMERS FROM SILICON NITRIDE CRYSTALS IN THE ELECTRON MICROSCOPE. Murr, L. E. (Univ. of Southern California, Los Angeles). Phil. Mag.; 25: No. 3, 721-8(Mar 1972).

Single-crystal Si_3N_4 ribbons were irradiated by a 125-keV electron beam in an electron microscope to produce charging and electrical corona. Under reduced vacuum conditions, residual hydrocarbon contamination was observed to build up on the corona streamers to produce a kind of fossilized structure. The fossilized corona streamers were observed to be similar in appearance to Lichtenberg figures, but intrinsically more microscopical in detail. (auth)

27332 OPTICAL PROPERTIES OF SEMICONDUCTING VO_2 FILMS. Gavini, Anibal; Kwan, Clarence C. Y. (Superior Electronics Inc., Montreal). Phys. Rev., B; 5: No. 8, 3138-43(15 Apr 1972).

The reflectivity of a thick sputtered film of VO_2 was measured in the energy range 0.5 to 11.0 eV at room temperature. The complex dielectric constant (ϵ_1,ϵ_2) and the complex index of refraction (n,k) were obtained from the reflectivity measurements using the Kramers–Kronig relations. Also measured was the transverse electroabsorption spectrum of a thin sputtered film of VO_2 at liquid-nitrogen temperature. Comparison of the electroabsorption spectrum with theoretical predictions identifies the edge at 2.011 eV as corresponding to a direct transition at an M_0 edge. In spite of the lack of a band-structure calculation for VO_2, the singularities in ϵ_2 at 0.6, 1.04, 1.32, 1.82, 2.64, 3.6, 5.89, and 9.6 eV are assigned to specific interband transitions. (auth)

27333 NUCLEAR SPIN-LATTICE RELAXATION IN THE $La_{1-c}Gd_cAl_2$ INTERMETALLIC COMPOUNDS. McHenry, M. R. (Univ. of California, Santa Barbara); Silbernage, B. G.; Wernick, J. H. Phys. Rev., B; 5: No. 8, 2958-72(15 Apr 1972).

The contribution of Gd impurities to the spin–lattice relaxation of ^{139}La and ^{27}Al nuclei in the compound $La_{1-c}Gd_cAl_2$ is studied for values of c from 0.0013 to 0.10, applied magnetic fields between 3.6 and 24.4 kOe, and temperatures from 1.2 to 300 K. The impurity component of the magnetization recovery for ^{27}Al is characterized by an $\exp[-(t/T_1)^{\frac{1}{2}}]$ time dependence, indicating diffusionless relaxation of the nuclei to the impurity. The recovery rate $1/T_1$ has a temperature and magnetic field dependence described by the derivative of the Brillouin function, and is found to be proportional to the impurity concentration. Longitudinal dipolar fluctuations of the Gd moments are the principal source of the impurity relaxation, and these fluctuations result from a spin–spin interaction between impurities. An analysis in the free-electron approximation indicates that a Ruderman–Kittel–Kasuya–Yosida coupling is the source of this interaction and yields a value of $J_{sf} \simeq 0.09$ eV for the strength of the conduction-electron–rare-earth coupling constant. A comparison is made with previous magnetization, susceptibility, and paramagnetic-resonance studies in the same system. (auth)

27334 TRANSPORT PROPERTIES AND THE ELECTRONIC STRUCTURE OF $LaSn_{3-x}In_x$. Grobman, Warren D. (IBM Watson Research Center, Yorktown Heights, N. Y.). Phys. Rev., B; 5: No. 8, 2924-31(15 Apr 1972).

Measurements of resistivity, magnetoresistance, and thermopower were made on a series of compounds of the type $LaSn_{3-x}In_x$ for temperatures from 1.5 to over 300 K. In addition, Hall effect in $LaIn_3$ was measured from 10 to 270 K. These experiments are interpreted in the light of previous data on these compounds with the object of obtaining a better understanding of their electronic structure. The main conclusions are that these compounds are transition metals which possess neither local moments nor magnetic phase transitions. They contain small pockets of electrons near the Fermi surface for x = 0 which disappear as x approaches unity. This result is consistent with measurements of magnetic susceptibilities and superconducting properties. Finally, arguments are presented based on thermopower measurements, which indicate that Ce in $LaIn_3$ is a Kondo system. (auth)

27335 ELECTRICAL AND MAGNETIC PROPERTIES OF TiO AND VO. Banus, M. D.; Reed, T. B.; Strauss, A. J. (Massachusetts Inst. of Tech., Lexington). Phys. Rev., B; 5: No. 8, 2775-84(15 Apr 1972).

The cubic compounds TiO_x and VO_x have a broad homogeneity range with x varying from about 0.75 to 1.30 and a total vacancy content varying between 11 and 20%. Golden TiO_x is a typical metal with a temperature- and composition-independent resis-

tivity of about 3×10^{-3} Ω cm, a Seebeck coefficient varying from +1 to −10 μV/°C, a susceptibility of less than 10^{-4} emu/mole and a superconducting transition temperature between 0.4 and 1.0 K for all compositions. VO_x behaves in a qualitatively similar manner for $x < 1.0$. However, it exhibits semiconductor behavior for $x > 1.0$, where its resistivity is highly temperature- and composition-dependent with an activation energy ($150 < T < 300$ K) rising to about 4×10^{-2} eV for $x = 1.3$. The Seebeck coefficient curve of VO_x is sigmoid, with α increasing from −12 to +22 μV/°C as x increases from 0.8 to 1.3. The magnetic susceptibility can be described by using a temperature-independent susceptibility and a Curie–Weiss term. VO_x is not a superconductor above 0.3 K for any composition. The total number of vacancies in these compounds can be reduced as much as 22% by annealing at 1300°C at pressures of about 60 kbar. This decrease in vacancy concentration is accompanied by a decrease in resistivity and Seebeck coefficient. The superconducting transition temperature of TiO_x is increased to as high as 1.0 K. Although TiO_x samples as normally prepared by arc melting are cubic with random vacancies at low temperatures, related ordered structures can be produced by annealing certain compositions at atmospheric pressure. Annealing samples with $x = 1.0$ below the transition temperature of 900°C produces an ordered monoclinic structure whose properties are discussed. (auth)

27336 INFLUENCE OF ATOMIC VACANCIES ON THE PROPERTIES OF TRANSITION-METAL OXIDES. I. TiO_x AND VO_x. Goodenough, John B. (Massachusetts Inst. of Tech., Lexington). Phys. Rev., B; 5: No. 8, 2764-74(15 Apr 1972).

After a brief review of the principal features associated with energy-band diagrams of ideal transition-metal monoxides having localized vs itinerant d electrons, modification of these diagrams is discussed for real crystals in the systems TiO_x and VO_x, which have itinerant d electrons. Each of these systems contains approximately 16% spontaneous atomic vacancies, and physical arguments are presented for the influence of these vacancies on the one-electron energies for both ordered and disordered crystals. It is argued that isolated cation vacancies tend to trap two holes, and anion vacancies to trap two electrons. The character of these trap states can be described for ordered systems. Disordered vacancies appear to create energy bands having features similar to those found in amorphous materials. The rather striking physical properties of the VO_x system can be qualitatively understood from physical arguments alone, as can the contrast between these properties and those found in TiO_x. (auth)

27337 EFFECT OF HIGH PRESSURE ON THE QUADRUPOLE INTERACTION IN Cd METAL MEASURED BY PERTURBED ANGULAR CORRELATIONS. Raghavan, P.; Raghavan, R. S.; Holzapfel, W. B. (Univ., Munich). Phys. Rev. Lett.; 28: No. 14, 903-6(3 Apr 1972).

The quadrupole interaction of the 247-keV level of ^{111}Cd in Cd metal under pressures up to 75 kbar was measured with the aid of time-differential perturbed angular correlations. The quadrupole interaction decreases by about 30% in this pressure range, the variation being nearly linear. The significance of these data to the understanding of the electric field gradient in Cd metal is discussed. (auth)

27338 CHANGE IN THE DECAY CONSTANT OF ^{99m}Tc IN $BaTiO_3$ BY THE FERROELECTRIC TRANSITION. Nishi, Masatsugu; Shimizu, Sakae (Kyoto Univ.). Phys. Rev., B; 5: No. 8, 3218-21(15 Apr 1972).

The $BaTiO_3$ ceramic samples were prepared by sintering mixtures of $BaCO_3$, TiO_2, and $Na^{99m}TcO_4$ at 1400°C. In these samples ^{99m}Tc atoms are located at the lattice site of the Ti atoms in the $BaTiO_3$ crystals, where an intense internal electric field acts. The relative change in the decay rate of the 2.17-keV E3 isomeric transition of ^{99m}Tc embedded in $BaTiO_3$ in the ferroelectric state (at room temperature) and the paraelectric state (at 170°C) was measured. The result obtained is $\lambda[BaTi(^{99m}Tc)O_3$ in paraelectric state$] - \lambda[BaTi(^{99m}Tc)O_3$ in ferroelectric state$] = (2.6 \pm 0.4) \times 10^{-3}\lambda[BaTi(^{99m}Tc)O_3$ in ferroelectric state]. Statistics and errors of the measurement are discussed. It is reasonable to conclude that the main contribution to the observed effect comes from a change in the 4p electron density near the nucleus caused by the influence of the internal electric field in $BaTiO_3$. (auth)

27339 LOW-TEMPERATURE RECOVERY OF PLASTICALLY DEFORMED CADMIUM, INDIUM, TIN, AND LEAD. Swanson, M. L.; Quenneville, A. F. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Status Solidi (a); 9: No. 1, 135-44(16 Jan 1972).

The recovery of the electrical resistivity increment produced by tensile plastic deformation of Cd, In, and Pb, and by compressive plastic deformation of In and Sn was investigated. The isochronal recovery of Cd has many similarities to the recovery after thermal neutron irradiation, with recovery stages at 4 to 10°K, 10 to 20°K, and 60 to 75°K. Recovery stages were observed for Pb at 9, 70, 160, and 280°K. The 70°K stage was attributed to migration of intrinsic defects, perhaps self-interstitials, the 160°K stage tentatively to migration of vacancies and the 280°K stage to recrystallization. For Sn, the superconducting transition temperature T_c was increased 0.11°K by a compressive deformation at 4.2°K which produced a resistivity increment $\Delta\rho_0 = 8.6 \times 10^{-8}$ Ωcm. Since the recovery of ΔT_c was almost complete at 120°K, while the recovery of $\Delta\rho$ was less than 50%, it was concluded that point defects caused the change in T_c for Sn. (auth)

27340 DIRECT CORRELATION BETWEEN LATTICE FRINGES AND ATOMIC POSITIONS IN DEFECT STRUCTURES IN N-NIOBIUM OXIDE. Hutchison, J. L.; Anderson, J. S. (Oxford Univ.). Phys. Status Solidi (a); 9: No. 1, 207-13(16 Jan 1972).

An electron-microscope study of N−Nb_2O_5 is described. From a consideration of various intergrowths it is possible to assign specific contrast features in the lattice image to structural features, such as "extra" niobium atoms, within the crystal lattice. Although atomic positions were not resolved, their positions in the lattice image were revealed in this way. Thus, detailed analysis of defects and disorder within the crystals may be made. (auth)

27341 MAGNETIC BEHAVIOR OF HEXAGONAL U_2N_3 IN THE TEMPERATURE RANGE FROM 77 TO 300°K. Nasu, S.; Tamaki, M.; Tagawa, H.; Kikuchi, T. (Japan Atomic Energy Research Inst., Tokai). Phys. Status Solidi (a); 9: No. 1, 317-21(16 Jan 1972).

The magnetic properties of hexagonal U_2N_3 were investigated in various magnetic fields in the temperature range from 77 to 300°K. The magnetization versus temperature curves exhibited a pronounced maximum which shifted to lower temperatures with increasing magnetic field strength. On the other hand, in the case of cooling the sample through the Curie temperature in a magnetic field, no peak in magnetization versus temperature curves occurred. These behaviors seem to be associated with a high-anisotropy field below the Curie temperature. The large magnetic hysteresis effect at 77°K confirmed these arguments. The paramagnetic susceptibility obeyed the Curie–Weiss law, having a Weiss constant of 182°K and a paramagnetic moment of 2.88 BM. The anisotropy and the paramagnetic moment are qualitatively discussed in terms of crystal field theory. (auth)

Moessbauer Effects and NMR

Refer also to abstracts 26963, 26985, and 27099.

27342 MAGNETIC RESONANCE OF Au:^{167}ErAND Au:^{171}Yb. Chock, E. P.; Davidov, D.; Orbach, R.; Rettori, C.; Tao, L. J. (Univ. of California, Los Angeles). Phys. Rev., B; 5: No. 7, 2735-6(1 Apr 1972).

The hyperfine splitting of (enriched) Au: ^{167}Er and Au: ^{171}Yb dilute alloys is reported. The absence of the signal from the $I \neq 0$ isotopes enables a more accurate determination to be made of the hyperfine splitting parameter and of the temperature dependence of the linewidth than in a previous publication. (auth)

27343 NUCLEAR MAGNETIC RESONANCE IN SUPERCONDUCTORS AND DILUTE ALLOYS. Vijayaraghavan, R. (Tata Inst. of Fundamental Research, Bombay). pp 261-71 of Modern Aspects of Solid State Chemistry. /Rao, C. N. R. (ed.). New York; Plenum Publishing Corp. (1970).

The spin susceptibility and the Knight shift of superconducting V_3Ga and V_3Si are considered, and the orbital contribution to them is examined. Changes in resonance line width in dilute alloys of transition metal impurities in nonmagnetic metals are considered and NMR data of ^{63}Cu in dilute alloys of Mn, Fe, Cr, and Co in Cu metal and of ^{51}V in Au–V alloys are discussed. (D.L.C.)

27344 MOESSBAUER EFFECT IN DYNAMICS OF ATOMIC MOTION IN SOLIDS. Bhide, V. G. (National Physical Lab., New Delhi). pp 287-327 of Modern Aspects of Solid State Chemistry. /Rao, C. N. R. (ed.). New York; Plenum Publishing Corp. (1970).

The historical discovery and principles of resonance fluorescence are discussed. The difficulties in observing the Moessbauer effect and its mechanism are described. The power of the Moessbauer technique to study atomic motions is considered. Experimental work on the determination of the Lamb Moessbauer factor and the second-order Doppler shift are reviewed. (57 references) (D.L.C.)

27345 PARAMAGNETIC RESONANCE OF $^{154}Gd^{3+}$ IN A ThO_2 SINGLE CRYSTAL: STUDY OF THE HYPERFINE STRUCTURE (ALLOWED AND FORBIDDEN LINES). Bœquet, G. (CNRS,

Toulouse); Dugas, J.; Escribe, C.; Vallilieff, L.; Wanklyn, B. M. Phys. Rev., B; 5: No. 7, 2419-25(1 Apr 1972).

The hyperfine structure of $^{155}Gd^{3+}$ ions in Th^{4+} substitutional cubic sites of a single crystal of ThO_2 (fluorite structure) was studied by means of electron paramagnetic resonance techniques. The observation of "forbidden" transitions traditionally labeled by $\Delta m = 1$ to 2 is reported. Theoretical calculations using first-order perturbation theory for the hyperfine structure and nuclear Zeeman terms after a numerical diagonalization of the remaining (electronic Zeeman plus crystal-field terms) spin Hamiltonian are in good agreement with experimental results. (auth)

27346 ^{51}V QUADRUPOLAR EFFECTS IN V-TRANSITION-METAL ALLOYS AND SOLUTIONS OF O AND N IN V. von Meerwall, E.; Rowland, T. J. (Univ. of Illinois, Urbana). Phys. Rev., B; 5: No. 7, 2480-8(1 Apr 1972).

The ^{51}V NMR in several V-based alloys with 3d, 4d, and 5d transition metals, and in dilute solid solutions of O and N in V, was used to study quadrupolar effects due to alloying. The results show these effects to be several times smaller for transition-metal (substitutional) solutes than for interstitial O and N in V. The solute dependence suggests that the field gradients around substitutional atoms arise mainly in response to local lattice distortion rather than to the shielding of the excess charge of the solute. A line-shape simulation based on an r^{-3} radial dependence of q produces good agreement with the observed absorption spectra. The all-or-nothing wipeout model, when applied to the interstitial alloys, yields wipeout numbers $n_1 = 126 \pm 7$ for N in V, and $n_1 = 194 \pm 12$ for O in V. The observed magnitude of the effective field gradients in V-based alloys is believed to result from a partial cancellation of the Sternheimer antishielding tendency by the overshielding effect of a large density of states near the Fermi level at the V atoms. (auth)

27347 T^2 TEMPERATURE DEPENDENCE OF ^{51}V KNIGHT SHIFT IN DILUTE Au–V ALLOYS. Kazama, S.; Kume, K.; Mizuno, K. (Tokyo Metropolitan Univ.). Phys. Lett.; 38A: No. 7, 483-4(27 Mar 1972).

^{51}V Knight shifts in dilute Au–V alloys were measured at 4 to 78°K by a spin-echo apparatus. Results are interpreted in terms of T^2 formula with $T_K = 265 \pm 25$°K. (auth)

27348 INTERPRETATION OF MOESSBAUER SPECTRA IN THIN IRON FILMS. Varma, M. N.; Hoffman, R. W. (Case Western Reserve Univ., Cleveland). J. Vac. Sci. Technol.; 9: No. 1, 177-80(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

Moessbauer spectra for films condensed and analyzed in uhv are reported in the thickness range 1 to 42 Å and from 15 to 350°K. The main features of the spectra can be explained in terms of superparamagnetic fluctuations of the magnetization within a given crystallite. Films in the thickness range 15 to 42 Å have a value of internal magnetic field which is slightly less than the 330 kG observed in bulk iron. As the films approach 12 Å, the hyperfine lines move inwards by about 16% when the temperature is raised from 15 to 350°K, but the lines are still well resolved. Assuming a simple uniaxial anisotropy model, the magnetization is stable on a time scale of the Larmor period for particles >90 Å average size and the magnetic hyperfine spectrum collapses to a doublet for particle size <70 Å. This is interpreted as arising from the complete collapse of the four excited state levels and the partial decrease of the ground state splitting corresponding to the superparamagnetic fluctuation time being limited by the frequency factor τ_0 rather than the volume or temperature. The large separation of the doublet in the 0.4-Å film is explained in terms of an electric field gradient at the iron nuclei due to the glass substrate or some contamination of the substrate. (auth)

27349 ELECTRIC FIELD GRADIENTS IN DILUTE COPPER ALLOYS. Schnakenberg, George Henry Frederick Jr. Pittsburgh; Carnegie-Mellon Univ. (1971). 106p. University Microfilms Order No 72-8070.

Thesis.

Electric field gradients (efg) at the nuclei close to the impurity in four dilute copper alloys were measured by NMR on single-crystal specimens of Cu containing ~1 at. % Ag, Au, Zn, or Cd. The ^{63}Cu resonance spectrum produced by the second-order nuclear quadrupole interaction with the efg at the first and second nearest-neighbor copper nuclei to the impurity was analyzed as a function of magnetic field orientation within the (011) plane. Both the strength q ($c^2qQ/2h$ in frequency units) and asymmetry parameter η of the efg tensor were determined at the first- and second-nearest neighbors. At the second-nearest neighbors, (1,0,0) type nuclei, $\eta = 0$. The zero-valence solutes Ag and Au produce efg's of greatly differing character in copper with the efg due to the Au being rather large (2.65 MHz) and axially symmetric ($\eta = 0.05$), while that of Ag is rather small (0.57 MHz) and quite asymmetric ($\eta = 0.75$) at the first-nearest neighbors. For Cu–Zn, the efg strength was 1.96 MHz with $\eta = 0.265$, and for Cu–Cd the efg strength was 1.52 MHz with $\eta = 0.03$ at the first-nearest neighbors. The striking feature is the increase of the efg component of the nearest neighbors along the [100] as the valence increases. The relatively large value of η in Cu–Zn supports the observation of B. Jensen et al. (1971) that in the Zn, Ga, Ge, As series, the efg component in the [100] dominates for Ge in Cu. The results also show that the current asymptotic theories based on conduction-electron scattering off the impurity which results in a spatially oscillating electron screening density are definitely not valid at the first- and second-nearest neighbors of the impurity and that a new theoretical approach is called for. The change in the Knight shift at the first- and second-neighbors was also measured in some cases and found to be unmeasurable or less than 3%. (TSS) (Diss. Abstr. Int., B)

27350 NUCLEAR MAGNETIC RESONANCE STUDY OF HYDROGEN DIFFUSION IN YTTRIUM TRIHYDRIDE. Weaver, H. T. (Sandia Labs., Albuquerque, N. Mex.). J. Chem. Phys.; 56: No. 7, 3193-9(1 Apr 1972).

Nuclear magnetic resonance measurements of spin–lattice relaxation time and resonance line shapes were carried out as a function of temperature in the range 77 to 715°K for ^1H contained in yttrium hydride. The composition ranged from $YH_{2.61}$ to $YH_{2.94}$ and included three samples in the hydrogen-deficient trihydride phase. Within limited temperature ranges, samples with higher hydrogen concentrations displayed complex line shapes and nonexponential magnetization recovery. These phenomena were associated with the formation of regions of YH_3 within the hydrogen-deficient structure. (auth)

PHYSICS (THEORETICAL)

Refer also to abstracts 26525, 26564, 26741, 26797, and 27361.

27351 (JINR–P2-6208) ON DETERMINATION OF THE PROBABILITY DENSITY IN NONRELATIVISTIC QUANTUM MECHANICS. Strel'tsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1971. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

Nonrelativistic transformation formulas are obtained for the density and probability current density. The procedure of proving the invariance of the equation of continuity in the nonrelativistic approximation is discussed. It is shown that use of an ordinary nonrelativistic expression for the probability density $\rho = |\Psi|^2$ leads to certain difficulties in considering the above-mentioned problems. (auth)

27352 (JINR–P4-6268) ON A COMPLETE SET OF QUANTUM-MECHANICAL OBSERVABLES IN THREE-DIMENSIONAL SPHERE. Lukach, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 28p. (In Russian). Dep. NTIS (U. S. Sales Only).

The problem of diagonal operators in a three-dimensional sphere is considered. A trigonometric form of the elliptic coordinate system in the sphere, suitable for application in physics, is presented. The wave eigenfunctions of the diagonal operators in the elliptic coordinate system, the so-called sphero-conical functions, are constructed. Their basic properties are given. The equations are derived, which determine the eigenvalues of the second diagonal operator in the elliptic coordinate system. Some matrix elements of sphero-conical functions are calculated. (auth)

27353 (JINR–P4-6269) SEPARATION OF VARIABLES IN THE SPHERO-CONICAL COORDINATE SYSTEM AND THE SCHROEDINGER EQUATION FOR A CASE OF NONCENTRAL FORCES. Lukach, I.; Smorodinskii, Ya. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

Separation of variables in the sphero-conical coordinate system, connected with the existence of the elliptic coordinate system on three-dimensional sphere, is considered. From the class of allowed potentials, the potential of the type $qr^{-4}[3(\vec{\alpha}\vec{r})(\vec{\beta}\vec{r}) - (\vec{\alpha}\vec{\beta})r^2]$, where $\vec{\alpha}$, $\vec{\beta}$ are arbitrary unit vectors, is of interest. The solution of the Schrödinger equation with such a potential leads to the wave Lame equation on reducing the angular part to the basic axes. The splitting of the energy levels is considered in the first-order perturbation theory for the case of the presence of such interaction for the Coulomb potential and for the potential with radius square-law variation. (auth)

27354 THERE IS A MEASUREMENT PROBLEM: A COMMENT. Fine, Arthur I. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., D; 5: No. 4, 1033(15 Feb 1972).

A possible difficulty is suggested with Moldauer's approach to the problem of measurement. (auth)

27355 IS THERE A QUANTUM MEASUREMENT PROBLEM? Moldauer, P. A. (Argonne National Lab., Ill.). Phys. Rev., D; 5: No. 4, 1028-32(15 Feb 1972).

It is shown that the quantum-mechanical state vector correctly describes not only the probabilities for the outcomes of measurements, but also the correlations between the outcomes of successive measurements. In particular, von Neumann's axiom M is shown to be redundant. Consequently, no extra-quantum-mechanical "reduction" of the joint object-apparatus state vector is required for a full statistical description of a sequence of measurements. It is also shown that any attempt to determine experimentally whether or not a reduction of the joint state vector has taken place during a measurement is incompatible with the preservation of the outcome of that measurement. (auth)

27356 SIMILARITY TRANSFORMATION OF THE SCHROEDINGER EQUATION AND ITS APPLICATION IN PSEUDO-POTENTIAL THEORY. Waeber, W. B. (Atomic Energy Research Establishment, Harwell, Eng.); Stoll, E. P. Physica; 58: No. 1, 88-108(1 Mar 1972).

The Schrödinger equation for stationary states is cast into the form of a new pseudo-potential equation by means of a similarity transformation. The eigenvalues and eigenstates of the transformed Hamiltonian can be expressed in terms of simple states with unusual ease. The transformation is model independent and not difficult to set up in a practical case, and should be useful for the purpose of first-principles calculations. Using this formalism an analytical expression for Austin, Heine and Sham's general pseudo-potential is obtained, and a simple condition for the smoothest possible representation of the eigenstates is derived. The eigenfunctions of the new pseudo-potential equation are equivalent to the pseudo wavefunctions of conventional pseudo-potential theor; though in the present treatment they are free from the possible indefiniteness associated with wavefunctions in pseudo-potential theory. The orthogonalization terms appearing in the pseudo-potential equation are eliminated, thus reducing it to a pure potential problem which is solved with a combined scheme of matrix algebra and time-independent perturbation theory. The formal solution may easily be specialized to a pure perturbation expansion as well as to the result of a simple matrix diagonalization. Reference is made to calculations in which the formalism has been used to calculate the band structure and other properties of bcc lithium. (auth)

27357 QUANTUM MECHANICS. Payen de la Garanderie, H. Paris; Masson (1971). 212p. (In French).

Mathematical methods leading to accurate solutions of atomic and molecular physics problems are presented. Wave functions are developed from the Schroedinger equation, and the operatoral formalism of quantum mechanics is introduced, kinetic moment operators being emphasized. Perturbation methods are discussed (the Rayleigh–Schroedinger method, the variational method, the self-consistent field method, and the atomic orbitals method). Spin and the Pauli principle are also introduced. (France)

27358 STRONGER FORM OF BELL'S INEQUALITY. Selleri, F. (Univ., Bari, Italy. Istituto Nazionale di Fisica Nucleare, Bari, Italy). Lett. Nuovo Cim.; 3: No. 14, 581-2(1 Apr 1972).

It is shown that a stronger form of Bell's inequality for the correlation functions calculated according to local hidden variable theories can be proven in a very simple way. (L.B.S.)

27359 INFORMATION AND ESTIMATION IN NUCLEAR MEASUREMENTS. Vaurio, J. K. (State Inst. for Technical Research, Otaniemi, Finland). Nucl. Instrum. Methods; 99: No. 2, 373-8(1972).

The roles of information theory and estimation theory in nuclear measurements are discussed. The results may be used for comparing, combining, and classifying various measurements. (auth)

27360 NECESSARY AND SUFFICIENT CONDITIONS FOR A CANONICAL TRANSFORMATION. Hurley, James (Univ. of California, Davis). Amer. J. Phys.; 40: No. 4, 533-5(Apr 1972).

Necessary and sufficient conditions are given for a transformation to be canonical. It is shown that if the transformation is to be canonical for all Hamiltonians, the condition is equivalent to the usual fundamental Poisson bracket conditions. (auth)

27361 SYMMETRIES AND INVARIANCES OF CANONICAL THEORIES. Anderson, James L. (Stevens Inst. of Tech., Hoboken, N. J.). Amer. J. Phys.; 40: No. 4, 541-4(Apr 1972).

The concepts of symmetry and invariance within the framework of the canonical formalism as defined in a number of standard texts on classical mechanics are not, in general, equivalent to the definitions of these concepts as used in other areas of physics, e.g., quantum mechanics, relativity, elementary particle theory. Definitions of these concepts are given in terms of infinitesimal canonical transformations that are in agreement with their generally accepted definitions, and the relation between them is discussed. (auth)

27362 LONG-RANGE CORRELATIONS OF THE DISTRIBUTION FUNCTIONS IN THE CANONICAL ENSEMBLE. Hiroike, Kazuo (Tohoku Univ., Sendai). J. Phys. Soc. Jap.; 32: No. 4, 904-11(Apr 1972).

Theories of Mayer and Lebowitz–Percus are examined which treat the N^{-1} dependence of the distribution functions in the canonical ensemble consisting of the systems with the particle number N. It is found that the expressions obtained by Lebowitz and Percus are more accurate than Mayer's ones. The same long-range correlations of the distribution functions are given by both theories. (auth)

27363 PERTURBATION THEORY FOR WEAKLY BOUND STATES. Ostrovskii, V. N.; Solov'ev, E. A. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz.; 62: No. 1, 167-72(Jan 1972). (In Russian).

The presence of level energy branching points as a function of perturbation parameter is characteristic for two cases when the applicability of perturbation theory is violated for a discrete level (several close levels and a level close to the continuous spectrum boundary). A modified perturbation theory developed in the present paper for the second case yields the level width, providing the

level becomes quasistationary under action of the perturbation. (auth)

27364 REDUCTION OF A SYSTEM OF COUPLED EQUATIONS IN THE HYPERSPHERIC FORMALISM. Fabre de la Ripelle, Michel (Paris Univ., Orsay, France). Compt. Rend., Ser. B; 274: No. 2, 104-7(10 Jan 1972). (In French).

The infinite system of differential equations linked with the hyperspheric formalism is reduced to three coupled differential equations by utilizing a prior diagonalization of the orbital part. A definition is given of the reduced base of the expansion used and the form of the coupled equations. (France)

27365 HARTREE–FOCK TECHNIQUES IN THE LIOUVILLE THEORY OF NONEQUILIBRIUM FERMI SYSTEMS. Reichl, L. E. (Univ. of Texas, Austin). Physica; 58: No. 1, 1-25(1 Mar 1972).

Hartree–Fock resummation techniques are applied to the time-dependent Liouville theory of nonequilibrium Fermi systems. Expressions for the reduced density matrices are obtained in terms of Liouville expansions which depend only upon single-particle energies modified to include the effects of interaction with the medium. (auth)

27366 UTILIZATION OF A VARIATIONAL PRINCIPLE IN STUDYING THE RELATIVISTIC BOLTZMANN EQUATION. Vignon, Bernard (Univ., Dijon, France). Compt. Rend., Ser. A; 273: No. 25, 1331-4(20 Dec 1971). (In French).

The relativistic generalization of a variational principle is established; this permits an approximate solution of a linearized Boltzmann equation to be obtained. (auth)

27367 CORRELATION OPERATORS IN MANY-PARTICLE PHYSICS. Bosse, Juergen (Freie Univ., Berlin). Z. Phys.; 251: No. 1, 30-41(1972).

Correlation functions and thermodynamic Green's functions are expressed as matrix elements of corresponding superoperators. A connection between the superoperator formalism, which has been used extensively in relaxation problems and in magnetism in recent years, and the method of thermodynamic Green's functions is thus established. The introduction of correlation (super-) operators describing dynamical as well as statistical aspects of a physical system allows for an abstract formulation of the theory independent of any special representation which results in considerable formal simplifications. The investigation of the Laplace-transformed correlation operator leads to Dyson's equation with the self-energy explicitly expressed as a superoperator matrix element. (auth)

27368 NUMERICAL EVALUATION BY SPLINES OF THE FOURIER TRANSFORM AND THE LAPLACE TRANSFORM. Silliman, Sherwood Daniel. Madison, Wis.; Univ. of Wisconsin (1971). 114p. University Microfilms Order No. 72-2034. Thesis.

Quadrature formulas (q.f.) for the numerical evaluation of the Fourier, cosine, sine, and Laplace transformations are considered. Let S_n denote the class of spline functions of degree $n-1$ defined on the real line and having simple knots at the points $\nu + n/2$ for all integers ν. This means that $S(x) \in S_n$ provided that $S(x) \in C^{n-2}$ and that the restriction of $S(x)$ to any interval between consecutive knots is a polynomial of degree not exceeding $n-1$. Three different approaches are used to construct the q.f.: one either integrates an appropriate spline interpolant to $f(x)$, requires the q.f. to be exact for a particular sequence of so-called B-splines, or utilizes a particular monospline. In any case, the generality and utility achieved is due to the form of the splines used in particular to the components of these splines, the so-called B-splines. (TSS)

27369 FARADAY AND ITS SIGNIFICANCE IN DETERMINING THE FUNDAMENTAL CONSTANTS. Horsfield, A. (National Physical Lab., Teddington, Eng.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 343, 137-45(Aug 1971).

From International conference on precision measurement and fundamental constants; Gaithersburg, Md. (3 Aug 1970).

The principles of the electrolysis of solutions of electrolytes are briefly discussed and the Faraday is defined. Experimental methods are given, particularly details of precise determinations of the electrochemical equivalents of silver and of iodine, used in the determination of the Faraday. The accepted value of the Faraday (1970) is $96{,}487.0 \pm 1.6$ coulombs gram-equivalent^{-1}. The value of the Faraday, which is the product of the charge of the electron and Avogadro's number, is important in the evaluation of the fundamental physical constants and its role is summarized. Suggestions are made for future experimental work. (auth)

REACTOR TECHNOLOGY

Power Reactor Development

Refer also to abstracts 25487 and 25499.

27370 (NP–19209) PROGRESS REPORT ON RESEARCH AND DEVELOPMENT IN THE YEAR 1970. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (West Germany)). Oct 1971. 232p. (In German). Dep. NTIS (U. S. Sales Only).

Reported are research and development activities in the institutes and departments of the society for nuclear research during 1970. Included is work performed for the projects "fast breeder" and "fissionable material flux control." As in previous years, emphasized is the project "fast breeder." The nuclear research center Karlsruhe shows a trend toward application of its potential to non-nuclear problems which will continue in the future. Non-nuclear problems include data evaluation, new technologies, and environmental burdens. The nuclear area places increasing emphasis on isotope separation, production and application of actinides, and safety. (tr-auth)

27371 FLUID-COOLED NUCLEAR REACTORS OF THE RE-ENTRANT TYPE. Walker, Alexander (to British Nuclear Design and Construction Ltd.). British Patent 1,264,473. 23 Feb 1972. Filed 22 Feb 1968.

In fluid-cooled reactors of the re-entrant type the coolant fed to the reactor core is split, so that some enters the core at the charge face end and some at the opposite end. The fluid entering at the charge face passes through the core and mixes with other fluid at the opposite end, the mixed fluid then passing back through the core and thence into an outlet plenum or hot bore. The hot bore usually takes the form of a space within the pressure vessel and is isolated from the charge face end of the reactor core by a dividing wall extending across the vessel. The dividing wall lies in the path between the pressure vessel stand pipes and the charge face and must be penetrated to gain access to the fuel and control rod channels. In the system described guide tube extends between the stand pipe and corresponding fuel or control rod channel, or tubular extension therefrom. The guide tube may slide axially relative to the standpipe and channel and passes through an aperture in the dividing wall and through a second tube which is shorter than the guide tube. One end of this second tube is attached and sealed to the dividing wall and the other end similarly to the guide tube at an intermediate point along the length of the latter. The arrangement is such that relative movement between the dividing wall and the stand pipe is accommodated by the flexibility of the guide and second tubes and the relative axial movement permitted by the ends of the guide tube. The second tube preferably extends towards the charge face and the guide tube is preferably in two parts. (UK)

Physics and Core Engineering

Refer also to abstract 27562.

27372 (AECL–3663) FLUID TO FLUID MODELING OF CRITICAL HEAT FLUX: A COMPENSATED DISTORTION MODEL. Ahmad, S. Y. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Dec 1971. 58p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

Modeling is of practical importance in reducing the high cost of critical heat flux testing for boiling water power reactors. A method widely used is to replace water by a modeling fluid having a lower latent heat of vaporization. A generalized technique for such fluid modeling of critical heat flux is developed from classical dimensional analysis and theory of models. The problem of multiple distortion is solved by introducing a modeling parameter which is a function of Weber number and liquid and vapor superficial Reynolds numbers. The technique of compensated distortion is employed in the development of the modeling parameter. The resulting model was tested at different liquid/vapor density ratios for various Freon compounds, water, K, and CO_2, over a large range of mass flux and inlet subcooling, and in both the subcooled and quality regions. Excellent agreement is shown between experimental data and the modeling technique for circular, annular, and rod bundle geometries. (51 references) (auth)

27373 (AEEW-R–723) NUMERICAL APPROACH TO TRANSFER FUNCTION SYNTHESIS FOR REACTOR SPATIAL CONTROL STUDIES. Owens, D. H. (Atomic Energy Establishment, Winfrith (England)). Jan 1971. 58p. Dep. NTIS (U. S. Sales Only).

A set of linear equations suitable for investigations of the dynamics of the xenon-driven radial/azimuthal modes in a cylindrical power reactor is formulated. Their method of solution in terms of spatial transfer functions relating the response of some defined observation function in some region of the reactor to the application of a control mechanism in some other region is described. The approach is essentially numerical, and consists of the algebraic solution of a set of simultaneous, linear, first-order differential equations in time representing the dynamics of the (r,z,t) amplitude of each azimuthal mode. The method can be applied to the multi-energy-group approximation. An important assumption in the analysis is that of azimuthal symmetry of reactor steady state and dynamic equations. The method is applied to a hypothetical reactor system, and the results are presented in the form of frequency responses. (16 references)

27374 (BNWL–1633) MEASUREMENT OF PHYSICS PARAMETERS FOR A MSBR LATTICE IN THE HTLTR. Lippincott, E. P. (Battelle Pacific Northwest Labs., Richland, Wash.). Jan 1972. Contract AT(45-1)-1830. 46p. Dep. NTIS.

Measurements were made in the HTLTR on a thorium-^{233}U lattice designed to obtain neutronic parameters needed in the Molten Salt Breeder Reactor program. Measurements were made from 20 to 1000°C and included k_∞ for the base lattice and reactivity perturbations of a number of samples. The change of k_∞ with temperature was observed to be smaller than had been predicted by calculation, in qualitative agreement with experimental results from two previous ^{233}U lattices in the HTGR Series. (23 references) (auth)

27375 (EUR–4779) CARONTE: THE EURATOM MODULAR CALCULATIONAL SYSTEM. Buccari, G.; Fattori, G.; Mongini-Tamagnini, C.; Astigiano, F. (European Atomic Energy Community, Ispra (Italy). European Scientific Data Processing Center, Praxis Calcolo S.p.A., Milan (Italy)). 1972. 112p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 150.-.

The CARONTE system controls the automatic execution of a series of programs. The sequence is chosen by the user starting from a library of programs conveniently adapted. The CARONTE system strongly differs from the existing ones in its main principle, that for the class of programs to be inserted in the CARONTE program library, the data to be transferred between the programs need not be classified in a fixed format. Consequently, a program needs no previous significant modifications since its input data and output results do not have to be standardized in any way. They have only to be grouped in numbered models, to be transferred, under CARONTE control, to and/or from a datapool stored in auxiliary memory. A private datapool on tape can be obtained. Due to this, the models stored in the datapool by the executed programs may have to be mixed and elaborated to form an input model to a next program. Such an operation is performed, according to the wish of the user, by suitable transfer programs running under CARONTE control, and set up for each field of application. The possibility of relying on transfer programs for the elaboration of models, has been shown to be extremely advantageous since it permits the handling of programs of any class, without previously studying a classification of data transfer in the class, and with a minimum of modification. (9 references) (auth)

27376 (JAERI–1210) EXPANDA-5: ONE-DIMENSIONAL DIFFUSION EQUATION PROGRAM FOR FAST REACTORS CONSISTING OF TWO-REGION HEXAGONAL LATTICES. Suzuki, Tomoo; Katsuragi, Satoru (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). 28 Aug 1971. 17p. Dep. NTIS (U. S. Sales Only).

An advanced approximate treatment was developed for obtaining the effective cross sections of various nuclides in a hexagonal two-region lattice, consisting of pin-typed fuels and coolant. In this approximation, an assumption is made that the ratio ζ_1 of the flux in fuel part to the total flux ϕ in a cell does not vary significantly with energy so that the flux ϕ_1 in each part of fuel and coolant can be represented by a product of ϕ and ζ_1. This ζ_1 is calculated by the transport equation describing a cell system and using ζ_1, the effective cross sections of each nuclide in the cell are estimated. Based on the above treatment, a one-dimensional diffusion equation program EXPANDA-5 has been developed. The JAERI-fast set in 25 groups is utilized in this program. (13 references) (auth)

27377 (RT/FI–(71)25) GROUP REBALANCING TO INCREASE THE SPEED OF CONVERGENCE IN FAST REACTOR

DIFFUSION CALCULATIONS. Cepraga, D. G.; Loizzo, P. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 7 Sep 1971. 23p. Dep. NTIS (U. S. Sales Only).

The possibilities of solving more rapidly the diffusion equations of a fast reactor for the quantities of poison that brings the reactor to criticality using the group rebalancing technique are analyzed. Group rebalancing procedure consists of finding a set of numbers (by which group flux is multiplied) which insure that a neutron balance is achieved in each energy group as well as over all groups. The experience with the EXTER–LOCEP has shown that the number of iterations for convergence is smaller than that obtained with the usual method and convergence time is shorter. (5 references) (auth)

27378 APPLICATION OF ENERGY MODAL SYNTHESIS TO FAST REACTOR BURNUP CALCULATION. Kiguchi, Takashi (Atomic Energy Research Lab., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 9: No. 3, 143-56(Mar 1972).

The energy modal synthesis method is applied to neutron diffusion calculations in fast reactor burnup analysis. The reactors adopted as numerical test problems are sodium-cooled, mixed-oxide fueled two-zone-core breeders with 750, 2,500 and 3,750 MW thermal output. Three cases have been taken up, i.e., two-mode, three-mode and five-mode syntheses. The results are compared with reference 26-group calculations, as well as with collapsed two- and four-group approximations. A set of two standard modes were selected. These modes could be used in common to the design study of almost any kind of FBR's. The modes used in the three-mode synthesis are the infinite medium spectra of the cores and blanket materials. In five-mode synthesis, two burnup-modes were further added. The results of calculation indicated that the energy modal synthesis is superior to the few-group method in its accuracy for the same computer time employed, especially in evaluating strongly energy-spectrum dependent quantities, such as breeding ratio and blanket power. Also, the space–time behavior of the neutron energy spectrum can easily be grasped by examining the space–time behavior of only one parameter: the ratio of the mode-combining functions of the two modes selected. (12 references) (auth)

27379 STUDIES ON XENON AND REACTIVITY TRANSIENTS IN BOILING WATER REACTORS. DEVELOPMENT AND CAPABILITIES OF SPECIAL COMPUTER PROGRAMS. Lockau, J.; Schmidt, U. (AEG-Telefunken, Frankfurt am Main). Atomwirt., Atomtech.; 17: No. 3, 167-9(Mar 1972). (In German).

Comprehensively described are the programs AXEMO and COSTAX-BOIL which permit the calculation of xenon and reactivity transients, respectively, for axially subdivided cores. Organization of the programs is explained with block diagrams. The capabilities are examined on two examples for COSTAX-BOIL and on one example for AXEMO. As demonstrated by the examples, exact knowledge of the dynamic core behavior permits the design of installations controlling these transients. Calculation of measured transients shows superiority of axial models. (10 references) (tr-auth)

27380 OBSERVATION ON THE ROD BUNDLE THERMAL CRISIS CORRELATION, CISE-3. Gaudiosi, Gaetano (CNEN, Rome). Termotecnica (Milan); 26: No. 1, 41-53(Jan 1972). (In Italian).

After analyzing the structure of the CISE-3 heat transfer crisis correlation and the hypotheses on the operating parameters of CISE type subchannels (constancy of the specific flow rate, of the boiling length), the effects of the variability of the latter through the rod bundles are evaluated. The functional relations on the specific flow rate and on the boiling length in the subchannels, which were assumed on the basis of the adimensional group nA_i/A_R (derived from the group nA_i/A used in the CISE-3 correlation and suggested by some experiments made by General Electric), lead to some conclusions and give also indications on how to formulate a new correlation. (11 references) (auth)

27381 POWER-FLATTENED SEED-BLANKET REACTOR CORE. Shank, Richard C.; Zucker, Carl E.; Jones, David H.; Raab, Harry F. Jr.; Bayard, Robert T. (to United States Atomic Energy Commission). U. S. Patent 3,640,844. 8 Feb 1972. Filed 7 Nov 1969.

A seed-blanket breeder reactor core is described having a flattened power density distribution resulting from selective loading of fissile material in the reactor core to achieve a desired radial reactivity distribution. The seed geometry of fuel modules near the periphery of the core is altered so that their reactivity worth is greater than centrally located fuel modules. The increased reactivity of the peripheral modules causes the gross power distribution in the core to flatten. (Official Gazette)

Control and Instrumentation

27382 (ANCR-1033) CORROSION OF THERMOCOUPLE SHEATH MATERIALS IN A PRESSURIZED WATER REACTOR ENVIRONMENT. Tkach, J. D.; Meservey, R. H. (Aerojet Nuclear Co., Idaho Falls, Idaho). Feb 1972. Contract AT(10-1)-1375. 32p. Dep. NTIS.

The corrosive behavior of thermocouples in borated water was investigated at 650°F and 2500 psig, because this represented the design conditions of the Loss-of-Fluid Test (LOFT) reactor and of many other commercial power-generating PWR's. The LOFT reactor specifically requires many temperature measurements of the Zircaloy-4 fuel pin cladding using thermocouples having a 2000-hour operating lifetime. Thus, candidate thermocouple sheaths were selected and corrosion tested, both individually and welded to Zircaloy. The tests were performed in an autoclave in static water having 2000 ppM boron and 1–10 ppM oxygen. Operating conditions were 650°F and 2500 psig. Total time of the test was 2500 hours. Candidate thermocouple sheath materials for temperature measurements on Zircaloy were niobium-1% zirconium (Nb-1Zr), platinum, tantalum, titanium, and Zircaloy. These choices were based on weld compatibility with Zircaloy. Both Nb-1Zr and tantalum had rapid corrosion rates; the oxides formed in the process tended to spall, causing a weight loss. The spalling was indicative of nonadherent oxides and the material loss rendered these two metals unsuitable for PWR applications. Platinum exhibited no changes during the test. However, the platinum-to-Zircaloy welds contained intermetallics which exhibited accelerated corrosion rates, eventually causing the weldment to embrittle after approximately 1000 hours of testing. Titanium also showed excellent corrosion resistance during the test. However, titanium-to-Zircaloy tungsten-inert gas (TIG) arc-welded specimens showed rapid corrosion in the welds. The TIG process caused extensive mixing of the base metals in the weldment, and the titanium-zirconium alloy thus formed had a much greater corrosion rate than either titanium or zirconium alone. Additional specimens were welded using a LASER welder in which the weld process was extremely rapid and intermixing of the base metals was inhibited. This technique produced titanium-to-Zircaloy weldments that had corrosion rates comparable to that of Zircaloy. Based on the results of the long-term corrosion tests and on the weld metallurgy, titanium was recommended for use as a thermocouple sheath material when the thermocouples were to be welded to Zircaloy-clad fuel pins and tested in a PWR environment. (18 references) (auth)

27383 (CEA-CONF-1790) INSTRUMENTATION FOR CONTROL AND OPERATION OF POWER REACTORS. EXPERIMENTAL DEVELOPMENT AND REFLECTIONS. Furet, J.; Grangetas, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1971. 17p. (In French). (CONF-710340-4). Dep. NTIS (U. S. Sales Only).

From IAEA working group on operation and instrumentation of nuclear power plants; Vienna, Austria (15 Mar 1971).

The detectors developed in France can be adapted to different types of nuclear power plants. The most recent developments were in the area of neutron capture detectors, electronic subassemblies, control and numerical techniques, and improvement in the treatment of the signal. The factors affecting the development of instrumentation for the control of reactors are considered in some detail. (J.S.R.)

27384 SUITABILITY OF EUROPIUM AS ABSORBING MATERIAL IN FAST REACTORS. Spenke, H. (Interatom, Bensberg, Ger.). Atomwirt., Atomtech.; 17: No. 3, 161-4(Mar 1972). (In German).

Measurements show that suitability of europium oxide as absorbing material in sodium-cooled fast breeders is superior to tantalum and is equal to natural boron carbide. Therefore, it seems justified to consider europium oxide as absorbing material for the control system in fast breeders. Cost estimates show that raw material and production occupy the same range for tantalum, enriched borium carbide, and europium oxide. If new arguments against europium oxide do not arise, and if irradiation experiments yield favorable results, this absorbing material could represent the optimal solution to the control rod problem in fast reactors. (11 references) (tr-auth)

Containment Systems, Waste Processing, and Radiation Protection

27385 (ORNL-TM-3746) FAST REACTOR SHIELDING MONTHLY PROGRESS REPORT FOR JANUARY 1972, 189A NO. 10028, ACTIVITY NO. 40 01 61. Mynatt, F. R.; Gritzner, M. L.;

Maerker, R. E.; McGregor, B. J. (Oak Ridge National Lab., Tenn.). 25 Feb 1972. Contract W-7405-eng-26. 58p. Dep. NTIS.

FAST TEST REACTOR—neutron flux in cavity and vessel support system of, (T)
LIQUID METAL FAST BREEDER REACTOR—coolant of, neutron shielding effects of sodium, (E/T)
NEUTRONS—attenuation in liquid sodium, (E/T)
SODIUM—neutron attenuation in, (E/T)
TOWER SHIELDING FACILITY—pipe chase mockup in, neutron streaming in, (E/T) (H.D.R.)

27386 (TID-25961) SAFETY GUIDE 18: STRUCTURAL ACCEPTANCE TEST FOR CONCRETE PRIMARY REACTOR CONTAINMENTS. [Division of Reactor Standards (AEC), Washington, D. C.]. 27 Oct 1971. 12p. USAEC.

27387 (WARD-3045-T-4-A-1) RADIAL BLANKET AND SHIELD SIMULATION EXPERIMENTS. First Quarterly Progress Report for Period Ending December 31, 1971. Dyos, M. W. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Feb 1972. Contract AT(11-1)-3045. 23p. Dep. NTIS.

To predict the shielding requirements for the LMFBR, a simulation of the radial blanket, reflector, core barrel, and pressure vessel is being constructed. The material selection for the spectrum modifier has been completed subject to more detailed confirmatory calculations. Calculated neutron spectra for the proposed radial shield experiment have been compared with the corresponding spectra calculated for the LMFBR Demonstration Plant (Demo). The experimental simulation spectra are found to be in satisfactory agreement with the plant spectra. Alternate materials to replace sodium in the radial blanket calandria of the simulation have been examined. This study was made to consider alternatives if future examinations find that sodium filling of the calandria is excessively difficult or expensive. Results of this study indicate that anhydrous Na_2CO_3 or atomized aluminum could be substituted for sodium in the blanket assemblies without seriously altering the neutron transmission through the blanket. Layout drawings for the shielding test simulation and detailed layout drawings of the blanket assemblies have been completed and reviewed. Preliminary manufacturing drawings of the radial shield components have also been completed and are currently being reviewed. (auth)

Coolant System

Refer also to abstracts 26007, 26012, 26014, 26015, 26018, 26020, and 26089.

27388 (NEDO-13129) CORROSION PRODUCT CHEMISTRY OF A BOILING WATER REACTOR. Sawochka, S. G.; Pearl, W. L. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Sep 1970. 38p. (CONF-701066-1). Dep. NTIS (U. S. Sales Only).

From thirty-first international water conference; Pittsburgh, Pa. (27 Oct 1970).

Design and operation aspects of direct-cycle boiling water reactors that affect primary coolant chemistry are examined. Chemistry of the feedwater system and the effects it has on corrosion product input to the primary system are discussed. The minimization of copper alloys in both the feedwater and primary systems has resulted in dramatic improvements in the chemistry of these systems. Operating data from plants with a minimum of copper alloys in these systems are presented, and the benefits from operation with improved water chemistry are discussed. 14 references. (H.D.R.)

27389 IMPROVEMENTS IN ELECTROCHEMICAL CARBON METER. (to United Nuclear Corp.). British Patent 1,261,845. 26 Jan 1972. Priority date 14 Apr 1969, United States.

CARBON—detector for liquid metal cooled fast reactor cooling system, design characteristics of electrochemical
GAGES AND METERS—design characteristics of electrochemical, for monitoring carbon in liquid metal cooled fast reactor cooling system
REACTORS, FAST—cooling system for liquid metal cooled, design characteristics of electrochemical carbon meter for
REACTORS, LIQUID METAL-COOLED—cooling system for fast, design characteristics of electrochemical carbon meter for (D.C.C.)

27390 IMPROVEMENTS IN AND RELATING TO SEALING DEVICES. (to Maschinenfabrik Andritz Aktiengesellschaft). British Patent 1,266,258. 8 Mar 1972. Priority date 31 Mar 1969, Austria.

PUMPS—seals for liquid cooled reactors, design characteristics of shaft
REACTORS, LIQUID METAL-COOLED—pump for, design characteristics of shaft seal for coolant
REACTORS, WATER-COOLED—pump for, design characteristics of shaft seal for coolant
SEALS AND GLANDS—design characteristics of pump shaft, for liquid cooled reactors (D.C.C.)

27391 VIBRATION OF TUBE BANKS IN HEAT EXCHANGERS. Mochizuki, Hiroji; Funakawa, Masaya; Umakoshi, Ritsuro (Kawasaki Heavy Industries, Ltd., Kobe, Japan). Kawasaki Giho; No. 38, 57-63(Jul 1970). (In Japanese).

Heat-exchangers for atomic power plants or steam power plants sometimes are damaged due to vibration of tubes or to acoustic resonance in ducts containing tube banks, caused by vortex shedding behind the tubes. To analyze vibrational effects on the tube banks and to establish design criteria for steam raising units, model tube banks of the steam raising unit for an advanced gas cooled reactor were constructed in a wind tunnel. Moreover, as the steam raising unit for the advanced gas cooled reactor is larger than that for CO_2 cooled reactors, and high pressure and high temperature gas flows in the ducts containing tube banks, experiments in the range of high Reynolds number were also done. Results of the experiments are reported, and vibrational characteristics of the tube banks founded on these results are discussed. (Japan)

27392 CIRCULATING WATER PUMPS FOR A NUCLEAR POWER STATION OF LARGE CAPACITY IN THE U. S. A. Muryama, Susumu (Hitachi Ltd., Tokyo). Sangyo Kikai; No. 248, 31-4(May 1971). (In Japanese).

Circulating water pumps manufactured for a nuclear power station in the U.S.A. are described. Six pumps were ordered for 2 1,100 MW units of the station, 3 pumps to be installed to each unit. Features associated with this pumping facility are: (1) adoption of synchronous motors to drive vertical-shaft mixed-flow pumps, replaceable casing shroud, implanted impeller blades and rubber bearings with water lubrication; and (2) an extraordinary long shaft of the pumps. Materials and tests are required to comply with standards in the U.S.A., while composition of the materials according to JIS is permitted. Penalty for unsatisfactory capability of products is very severe, and operational tests are planned. (Japan)

Fuels and Fuel Elements

Refer also to abstracts 26008, 26009, 26019, and 26088.

27393 (AECL-4072) MEASUREMENTS OF THE CIRCUMFERENTIAL STRAINS OF THE SHEATHING OF UO_2 FUEL ELEMENTS DURING REACTOR OPERATION. Notley, M. J. F.; Pettigrew, M. J.; Vidal, H. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Jan 1972. 24p. Dep. NTIS (U. S. Sales Only). AECL $1.00.

Resistance strain gauges were used to measure circumferential strains of Zircaloy sheathed UO_2 fuel elements during irradiation under nominal CANDU-BLW conditions. During the first startup to full power, fuel of density 10.71 g/cm^3 expanded as if no plastic deformation of the hottest regions of the fuel was occurring; fuel of density 10.56 g/cm^3 expanded less, as if the expansions of the regions above 1400°C were being accommodated in internal voidage (porosity, end face dishing, etc.). During subsequent power cycling the sheath strain cycle was generally less than 0.1%, and diminished progressively. Unless the strain is concentrated locally, the danger of fatigue during load following operations is therefore thought to be small. (16 references) (auth)

27394 (BNWL-SA-3961(Pt.2)) LATTICES OF PLUTONIUM-ENRICHED RODS IN LIGHT WATER. PART II. THEORETICAL ANALYSIS OF PLUTONIUM-FUELED SYSTEMS. Liikala, R. C.; Uotinen, V. O.; Jenquin, U. P. (Battelle Pacific Northwest Labs., Richland, Wash.). [1971]. Contract AT(45-1)-1830. 87p. Dep. NTIS.

A theoretical analysis of UO_2-PuO_2 fueled, light-water-moderated lattice experiments has been performed to aid in establishing technical bases and design criteria for the utilization of plutonium bearing fuel in thermal power reactors. Results for UO_2 and Al-Pu lattices are included in order to understand the effects due to uranium and plutonium separately. The problems involved in calculating critical experiments are discussed. Estimates of the effects of various approximations inherent in the theoretical methods and/or analysis procedures are included along with the consequence on the results of the correlation. Uncertainties in the measurements and the neutron cross-section data are related to uncertainties in the calculated values of k_{eff}. Areas

which should be investigated in future analyses are also identified. (84 references) (auth)

27395 (EURFNR-987) THEDRA: A CODE FOR THERMAL DESIGN RELIABILITY ANALYSIS OF A REACTOR CORE. Amendola, A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Dec 1971. 90p. (KFK-1507; EUR-4722). Dep. NTIS (U. S. Sales Only).

Work Performed under United States-Euratom Fast Reactor Exchange Program.

The Fortran-IV computer code THEDRA for thermal design reliability analysis of a reactor core is described. THEDRA allows the designer to get a complete reliability assessment of the core design against overtemperatures, since it evaluates: the expected number of hot spots in a core; the expected number of pins in which hot spots occur; the expected number of subassemblies containing hot pins; and the probability of no hot spot occurring in a core. By means of this analysis it is possible to evaluate the pin failure expectation, if the distribution of pin failures vs operating temperature is known. (10 references) (auth)

27396 (HEDL-TME-72-23) EXPERIMENTAL TEMPERATURE DISTRIBUTIONS IN LIQUID METAL FAST BREEDER REACTOR FUEL ASSEMBLIES, THE EFFECT OF BOWING DISTORTIONS. Collingham, R. E.; Yatabe, J. M.; Hill, V. R.; Thorne, W. L. (Hanford Engineering Development Lab., Richland, Wash.). Feb 1972. Contract AT(45-1)-2170. 24p. Dep. NTIS.

The results are presented of LMFBR 7-pin bundle electrically heated tests in sodium in which two pins were bowed to touching and the entire bundle bowed toward one flat. These tests indicate that such bowing caused significant but not extreme hot spots. When applied to reactor conditions, two pins in contact created an inner clad surface hot spot of less than 100°F. Temperature imbalances caused by bowing of the entire bundle were substantially smaller, amounting to less than 20°F. 8 references. (auth)

27397 (NP-19182) SUMMARY OF THE RADIATION EXPERIMENTS CARRIED OUT IN THE FRAMEWORK OF THE AVR REFUELING CHARGE. (Brown Boveri/Krupp Reaktorbau G.m.b.H., Duesseldorf (West Germany)). Apr 1968. 70p. (In German). Dep. NTIS (U. S. Sales Only).

Performed were reactor tests concerning specifications of refueling charges for the AVR. Specifications required irradiation of graphite, coated particles, and fuel elements. Graphite should change its length by less than 1.2% at doses of fast neutrons of about 2.10^{21} nvt and temperatures of about 1000°C. Coated particles should release less than 5×10^{-5} ^{133}Xe at a burnup of about 9% and at temperatures of more than 1250°C. Fuel elements should release less than 10^{-4} ^{133}Xe at a surface temperature of 1000°C and a mean power of 2.1 kW/sphere; the central temperature should not exceed 1250°C. Irradiation experiments were performed for graphite at the HFR/Petten and DFR/Dounreay reactors, for coated particles at the R2/Studsvik and BR2/Mol reactors, and for fuel elements in the DR3/RISO and the Dragon reactors. Examinations showed that the release of ^{133}Xe met specifications and that the mechanical behavior of all components was excellent following irradiation. (H.B.G.)

27398 (NP-19207) MOLTEN SALT BREEDER REACTOR CONCEPT. Quarterly Report for the Period Ending October 31, 1971. (Bhabha Atomic Research Centre, Bombay (India)). 15p. Dep. NTIS (U. S. Sales Only).

Chemical investigations on the feasibility of plutonium startup in a molten salt reactor were conducted. Results are presented for solubility measurements of PuF_3 in $LiF-BeF_2-ThF_4$ salt mixtures and in $LiF-ThF_4$ binary salt mixtures. (10 references) (H.D.R.)

27399 (NP-19239) LIMITING ASPECTS OF FUEL ELEMENT PERFORMANCE IN WATER COOLED POWER REACTORS. Advanced Course Organized by the Netherlands-Norwegian Reactor School at Institutt for Atomenergi, Norway, 24-28 August 1970. (Institutt for Atomenergi, Kjeller (Norway)). 361p. Dep. NTIS (U. S. Sales Only).

The performance of UO_2 fuels and cladding materials in water cooled reactors is reviewed with emphasis on the various life-limiting mechanisms. Specific topics discussed include: UO_2 properties; corrosion and hydrogen pickup of zirconium base cladding; Zircaloy cladding properties; mechanical interaction between fuel and cladding; comparison of pellet and vipac fuels; fuel melting; heat transfer in reactor cores; fuel element design; and defective fuel element behavior. (H.D.R.)

27400 (TID-25935) INTERRELATIONSHIP BETWEEN FUEL TEMPERATURE AND CLADDING STRAIN HISTORIES. Biancheria, A.; Harbourne, B. L.; Boltax, A. (Westinghouse Electric Corp. [Madison, Pa.]). [1972]. Contract AT(11-1)-3045. 4p. Dep. NTIS.

The MINIGRO computer program, a simplified version of CYGRO-F, was used to investigate the effects of fuel temperature history on LMFBR cladding deformation. The fuel temperature analysis includes dynamic fuel restructuring, densification by hot pressing, burnup-dependent conductivity, variable gap conductance, and power history. The fuel-cladding contact conductance increases with increasing mechanical interaction. The gas film conductance decreases with increasing fission gas contamination. Variations in fuel temperature history were obtained from analyses at constant power, at decreasing power, and with both constant and variable gap conductance. The predicted temperature histories are illustrated. (auth)

27401 (TUBIK-23) TWO-DIMENSIONAL MULTIREGION ANALYSIS OF TEMPERATURE FIELDS IN FINITE ROD BUNDLES COOLED BY LIQUID METALS. Wolf, L.; Johannsen, K. (Technische Universitaet, Berlin (West Germany). Institut fuer Kerntechnik). Sep 1971. 26p. (CONF-710903-9). Dep. NTIS (U. S. Sales Only).

From first international conference on structural mechanics in reactor technology; Berlin, Germany (20 Sep 1971).

The results are presented of a single-rod three-region (fuel, clad, coolant) analysis of steady-state fully developed heat transfer to slug flow along symmetrically posed corner and lateral rods of unbaffled hexagonal rod bundles with equilateral triangular spacing. Account is taken for thermal contact resistance at fuel-clad interface and clad surface. The effect of round displacers inserted into the peripheral flow channel is investigated. From the explicit temperature solutions obtained in terms of Fourier series, the effect of variations in geometrical parameters like pitch-to-diameter ratio, relative rod distance from the channel wall, and relative clad thickness as well as in thermal parameters like relative conductivities of fuel and clad on heat transfer and temperature distributions is studied. (30 references) (auth)

27402 (WCAP-3385-29) SAXTON PLUTONIUM PROJECT. Quarterly Progress Report for the Period Ending September 30, 1971. Caye, T. E. (Westinghouse Electric Corp., Pittsburgh, Pa.). Contract AT(11-1)-3044. 11p. Dep. NTIS.

PLUTONIUM—utilization in pressurized water reactor fuels, (E/T)
REACTORS, PRESSURIZED WATER—fuels for, utilization of plutonium in, (E/T)
SAXTON POWER REACTOR—operation during July through September 1971
—fuel elements for, performance of plutonium-enriched, (E/T) (H.D.R.)

27403 REACTIVITY AND POWER DISTRIBUTION CONTROL OF A NUCLEAR REACTOR CORE. Fischer, David Lloyd; Channon, Frederick Robert; Clancey, Walter Robert; (and others) (to General Electric Co.). British Patent 1,253,912. 17 Nov 1971. Priority date 26 Feb 1968, United States.

BURNABLE POISONS—core of, control of heterogeneous power reactor reactivity and power distribution by
REACTORS, HETEROGENEOUS—core for power, control of reactivity and power distribution by burnable poison
REACTORS, POWER—core for heterogeneous, control of reactivity and power distribution by burnable poison (D.C.C.)

Auxiliary Systems and Engineered Safeguards

27404 (ANL-EBR-17) CONCEPTUAL SYSTEM DESIGN DESCRIPTION OF THE SYSTEM FOR EMERGENCY REMOVAL OF EBR-II INSTRUMENTED SUBASSEMBLIES (INSER). EBR-II Project. Elias, P.; Hutter, E.; Seim, O. (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). Oct 1971. Contract W-31-109-eng-38. 39p. Dep. NTIS.

An instrumented subassembly is operated in the EBR-II reactor in place of control-rod-drive No. 6. After its irradiation in the reactor is completed, the instrumented subassembly is separated into two pieces by a cutting device. The upper part (extension tube) is removed by lifting it upward through the reactor-vessel cover and through the rotating shield plug into a receiver tube. The lower part (subassembly) is removed from the reactor and primary tank by the existing fuel-handling system. If the separation fails, the subassembly will be removed from the reactor by an emergency system. This system is composed of the following major components: (1) sealed container and shielding; (2) lower adapter tube; (3) storage tube; and (4) support structure. The lower adapter tube is attached to the control-rod-drive nozzle at the bellows-flange level (50 in. above the top of the small ro-

tating plug) and extends to the top of the control-rod-drive support column (about 100-in. level), where it is coupled to the sealed and shielded container—about 100 in. long. On the top of the container is secured the storage tube with a cutting machine at the lower end and a lifting device at the top. The assembly is attached to the support structure and the building crane. The instrumented subassembly is lifted in one piece into this assembly, cut into two parts (extension tube and subassembly) and then removed for storage or examination. (auth)

27405 COOLANT OVERPRESSURE-RESPONSIVE NUCLEAR REACTOR SHUTDOWN SYSTEM. Davies, S. M.; Vapaavouri, H. (to Canadian General Electric Co. Ltd.). Canadian Patent 881,794. 21 Sep 1971.

A control system for shutting down a nuclear reactor by dumping moderating liquid from the reactor is connected to a primary coolant circuit so the generation of over-pressure within the primary coolant circuit will produce direct actuation of the reactor shutdown system. The overpressure within the primary coolant circuit may occur as the result of the dumping of electrical load from an alternator powered by a steam turbine receiving steam from the primary coolant circuit. (F.S.A.) (Canada)

Operation and Economics

Refer also to abstract 27561.

27406 (RISO-232) SELF-MANAGEMENT, AN APPROACH TO OPTIMUM CORE MANAGEMENT OF THERMAL REACTORS BY MEANS OF IDEAL BURN-UP DISTRIBUTIONS. Thomsen, K. Ladekarl (Danish Atomic Energy Commission, Risoe, Research Establishment). Nov 1971. 129p. Dep. NTIS (U. S. Sales Only).

In the multistage process, part of the decisions are separated from the remaining decisions by means of an internal optimality condition. This condition is either (1) minimum power form factor or (2) maximum fuel burn-up with limited power form factor. The external decisions regarding the power form factor at which the reactor is wanted to be operated, the number of the N concentric regions refuelled per cycle, and the enrichment of the reload fuel, are assumed given. The model is a one-dimensional, one-group model. The state of the fuel is described by the quantity $Q = \Sigma_a(k_\infty - 1) - DB_z^2$. The regions with lowest Q are refuelled. Fuel shuffling is performed as a synthesis of a "best fit" of the actual Q-distribution to an ideal Q-distribution, applied as a reference distribution. The ideal Q-distribution corresponding to a specific internal optimality condition is determined at equilibrium core conditions by simple iterative methods. The automated shuffling works without support from flux calculations. An absorber power shaping routine keeps the power shape fixed at the ideal shape. (21 references) (auth) (Denmark)

27407 (TID-25957) SAFETY GUIDE 16: REPORTING OF OPERATING INFORMATION. [Division of Reactor Standards (AEC), Washington, D. C.]. 27 Oct 1971. 28p. USAEC.

Requirements for reporting information on the operation of nuclear power plants are discussed. The operating reports are required by AEC regulations or are specified in the facility technical specifications. (H.D.R.)

Safety and Siting

27408 (CENPD-26(Rev.1)) DESCRIPTION OF LOSS OF COOLANT CALCULATION PROCEDURES. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.). 14 Feb 1972. 166p.

Includes Supplements 1, 2, and 3.

The development and application of computer programs for analyzing coolant loss accidents in pressurized-water reactors are described. (30 references) (D.C.C.)

27409 (EURFNR-991) FAST REACTOR PROGRAMME. Combined Second and Third Quarters Progress Report, 1971. Hoekstra, E. K. (comp.) (Reactor Centrum Nederland, Petten). Jan 1972. 158p. (RCN-164). Dep. NTIS (U. S. Sales Only).

Work performed under United States-Euratom Fast Reactor Exchange Program.

The RCN program comprises reactor physics, fuel irradiations, advanced fuels, radiation damage in canning materials, analysis of impurities in sodium, aerosol research and heat transfer and hydraulics. (23 references) (auth)

27410 (FRNC-TH-141) TECHNIQUES FOR STUDYING GASEOUS-PHASE TRANSFER OF FISSION PRODUCTS. Brieu, Philippe (Aix-Marseilles Univ. (France). Faculte des Sciences). 1971. 90p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Accidents which may occur in reactors involve essentially the diffusion of fission products. An attempt was made to determine the parameters that modify the nature of the species produced and thus the contamination transfer. A molecular iodine generator was developed. The effect of various parameters on the physicochemical behavior of ^{131}I and ^{132}I was studied. A May-Pack type sampling device was developed and a certain number of analytical techniques were investigated (absorption by active C, and Ag activated Cu, streamline diffusion, molecular effusion, and gaseous phase chromatography). (52 references) (auth)

27411 (MRR-86) STATUS REPORT ON THE HIGH TEMPERATURE BEHAVIOR OF A LIGHT WATER MODERATED REACTOR CORE WITH UO_2 FUEL ELEMENTS ON COMPLETE BREAKDOWN OF THE EQUIPMENT FOR COOLING. Grosserichter, R. (Technische Hochschule, Munich (West Germany). Institut fuer Mess- und Regelungstechnik). Apr 1971. 42p. (In German). Dep. NTIS (U. S. Sales Only).

Reviewed are problems occurring in a superheated reactor core. It is concluded that heat transfer determines the behavior of the molten mass, integrity of pressure vessels and containment, as well as release of radioactive substances. To obtain more reliable data, further studies are suggested in the following fields: physical properties of UO_2, zirconium alloys, and corrosion-resistant steels at temperatures close to, or beyond, their melting points; behavior of the molten mass and its reaction with water and steam; amount of fission products in the molten mass and its contribution to further heat production; and the behavior of fission products, released by the fuel elements, in pressure vessels and containment. (H.B.G.)

27412 (ORNL-TM-3670) ORNL NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM BIMONTHLY REPORT FOR NOVEMBER-DECEMBER 1971. Cottrell, Wm. B. (Oak Ridge National Lab., Tenn.). Mar 1972. Contract W-7405-eng-26. 158p. Dep. NTIS.

The accomplishments during the months of November and December in the research and development program are summarized. Much of this work is in general support of water-cooled power reactor technology, including LOFT and industry programs, and reflects current safety problems, such as blowdown heat transfer studies. Several projects are also conducted in support of the high-temperature gas-cooled reactor (HTGR) and the liquid-metal fast breeder reactor (LMFBR) programs. Other major projects include experimental investigations of the attachment of nozzles to shells and the implementation of joint AEC-PVRC programs on heavy-section steel technology and nuclear piping, pumps, and valves. Seismic considerations of particular significance in nuclear plant design are evaluated in the seismic program. Several of the above projects are also directly related to another major undertaking, the AEC's standards program, which entails development of engineering safeguards and the establishment of codes and standards for government-owned or -sponsored reactor facilities. The recent activities of NSIC and the Nuclear Safety journal in behalf of the nuclear community are also discussed. Of particular interest in both of these activities is the recent emphasis on environmental effects. (auth)

27413 (RD/B/N-2193) TYPICAL EXPOSURE AND INHALATION ISOPLETHS FOLLOWING RADIOACTIVE RELEASES FROM NUCLEAR INSTALLATIONS. Beynon, S. M.; Clarke, R. H.; Felstead, L. D.; Macdonald, H. F. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jan 1972. 35p. Dep. NTIS (U. S. Sales Only).

The reactor safety analysis program WEERIE may be used to obtain downwind and crosswind inhalation doses and external γ-exposures from typical reactor releases under varying weather conditions. A computer program was developed which will process WEERIE output to provide: predicted Ge(Li) detector spectra at the point of interest; plots of dose as a function of downwind distance; and isopleths of dose or exposure in any x-y plane downwind of the reactor. These results are then of use in assessing both individual and population doses from accidental or operational releases of radioactivity. WEERIE data for a Magnox depressurization accident with single channel melt-down were obtained and the results are presented as dose-distance plots and isopleths for the 3 Pasquill weather categories B, D and F assuming either a ground level or 75 m stack release. (auth) (UK)

27414 (TID-25958) SAFETY GUIDE 15: TESTING OF REINFORCING BARS FOR CONCRETE STRUCTURES. [Division of

Reactor Standards (AEC), Washington, D. C.]. 27 Oct 1971. 3p. USAEC.

27415 (TID–25959) SAFETY GUIDE 14: REACTOR COOLANT PUMP FLYWHEEL INTEGRITY. [Division of Reactor Standards (AEC), Washington, D. C.]. 27 Oct 1971. 6p. USAEC.

Coolant pump flywheel materials, fabrication, testing, and inspection requirements to assure safe operation in water cooled reactors are presented. (H.D.R.)

27416 (TID–25963) SAFETY GUIDE 20: VIBRATION MEASUREMENTS ON REACTOR INTERNALS. [Division of Reactor Standards (AEC), Washington, D. C.]. 29 Dec 1971. 11p. USAEC.

A method is presented for preoperational vibration testing of reactor internals to demonstrate that flow-induced vibrations will not cause damage. (H.D.R.)

27417 (TID–25964) SAFETY GUIDE 21: MEASURING AND REPORTING OF EFFLUENTS FROM NUCLEAR POWER PLANTS. [Division of Reactor Standards (AEC), Washington, D. C.]. 29 Dec 1971. 13p. USAEC.

27418 (WCAP–7503(Rev.1)) DETERMINATION OF DESIGN PIPE BREAKS FOR THE WESTINGHOUSE REACTOR COOLANT SYSTEM. Szy Slow Ski, J. J.; Salvatori, R. (Westinghouse Electric Corp., Pittsburgh, Pa.). Feb 1972. 98p.

A fracture mechanics analysis of cracks in straight free piping runs of the Westinghouse Reactor Coolant System is presented. The analysis shows that if a "code-allowable" deep crack in a straight free piping run grows through-wall, it will yield fluid leakage that will be detected well before the crack reaches the critical length and the pipe ruptures. The analysis also shows that a "code-allowable" shallow crack in a straight free piping run will not reach the burst depth during the life of the plant. The formulas used in the analysis are supported by experimental data in the literature. The results of the analysis represent the basis for proposing that the Westinghouse Reactor Coolant System be designed only against circumferential breaks at points of high stress, or correspondingly, of high fatigue. 17 references. (auth)

27419 RADIATION SAFETY STANDARDS FOR APPROVAL OF RELEASE OF RADIOACTIVE MATERIALS. PART II. APPROVAL PROCEDURE FOR EFFLUENT WATER AND AIR. Schwibach, J. Atomwirt., Atomtech.; 17: No. 4, 196-8(Apr 1972). (In German).

Release of radioactive material from nuclear installations is approved by agencies only under the condition that specified maximal limits will not be exceeded. In addition to these maximal limits that were specified in regulations resulting mostly from ICRP recommendations, the BRD uses in approval procedures other standards which restrict emissions as far as possible and which are lower than the ICRP recommendations. Those restrictions create an additional safety factor for the radiation burden to the population. Radiation safety recommendations and regulations are discussed, and approval procedures are described. (tr-auth)

27420 DYNAMIC ANALYSIS OF REACTOR INTERNAL STRUCTURES WITH IMPACT BETWEEN COMPONENTS. Bohm, George J. (Westinghouse Electric Corp., Pittsburgh); Nahavandi, Amir N. Nucl. Sci. Eng.; 47: No. 4, 391-408(Apr 1972).

The dynamic analysis of the reactor internal structure in a typical pressurized-water reactor system, subjected to step, periodic, and seismic excitations, is presented. Employing the finite element approach of structural analysis, the governing differential equations describing the motion of the system are set up and integrated numerically in time. It is shown that the introduction of three types of structural elements, elastic, rigid and pin-joint members with nodes having three degrees of freedom, provides an adequate mathematical model for the solution of reactor structural dynamics problems. A main distinctive feature of this analysis is the application of "elements" global stiffness matrices in place of the standard structural global stiffness matrix. It is shown that this feature reduces the computer storage requirement and running time considerably. An examination of the system dynamic response characteristics indicates that when the clearance between the reactor internal components is relatively small, impact between various components could occur. The magnitude of the impact forces for periodic and seismic excitations is computed. Furthermore, a procedure for the calculation of the upper bound of integration time step is presented which ensures the numerical stability of the solution. (auth)

Commercial Power Reactors

27421 (AECL–4131) FLUX DISTRIBUTION MEASUREMENTS IN THE PICKERING UNIT 2 REACTOR. Okazaki, A.; Roshd, M. H. M. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Feb 1972. 45p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

Flux distribution measurements were made by copper wire activation during the low power commissioning of the 508 MW(e) Unit 2 reactor of the Pickering Generating Station. The distributions were measured along the center of the fuel bundles in two channels located 0.7 and 7.3 lattice pitches from the central axis of the reactor core. Wire scanners with NaI scintillation detectors were used to determine the wire activity. Measurements were made for 13 configurations of adjuster rods, shutoff rods, and zone control light water absorbers. (auth)

27422 (FIND–50317(3-72)) FIND: CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Smith, James G. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 31 Mar 1972. 30p. (FIND–50318(3-72)). Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

27423 (STI/PUB–296) DIRECTORY OF NUCLEAR REACTORS. VOL. IX. POWER REACTORS (SUPPLEMENT TO VOLS IV AND VII). (International Atomic Energy Agency, Vienna (Austria)). Oct 1971. 245p. IAEA $8.00.

Forty new power reactors at 31 nuclear power stations in 14 countries are described. The reactors are grouped by coolant with light-water-cooled reactors further sub-divided into pressurized and boiling-water systems. In each category reactors are listed chronologically according to their actual or expected date of first criticality. General information and reactor physics data are presented on the first page of each entry. The second and third pages provide diagrams of the fuel element or fuel assembly and of the horizontal and vertical sections of the reactor. Subsequent pages provide information under the following headings: core, fuel element, core heat transfer, control, reactor vessel, fluid flow, reflector and shielding, safety and containment, turbogenerator, and operation. (auth)

27424 (WAPD-PWR-TE–261) SHIPPINGPORT PWR CORE 2 SEED 2 PHYSICS TEST RESULTS AT ABOUT 3000 EQUIVALENT FULL POWER HOURS OF OPERATION TEST EVALUATION. Smith, F. E. (Bettis Atomic Power Lab., West Mifflin, Pa.). Dec 1970. Contract AT-11-1-GEN-14. 46p. Dep. NTIS.

A presentation and discussion of the results of physics tests performed on PWR Core 2 Seed 2 from 2893 through 2968 equivalent full power hours of operation are presented. These tests provided information on critical rod positions, reactivity coefficients, and xenon transient characteristics. Measured results are compared with calculated data and with earlier test data for PWR Core 2 Seed 2 and PWR Core 2 Seed 1. Good agreement between measured and calculated data was obtained. (auth)

27425 (WAPD-PWR-TE–262) SHIPPINGPORT PWR CORE 2 SEED 2 PHYSICS TEST RESULTS AT ABOUT 5000 EQUIVALENT FULL POWER HOURS OF OPERATION TEST EVALUATION. Smith, F. E. (Bettis Atomic Power Lab., West Mifflin, Pa.). May 1971. Contract AT-11-GEN-14. 39p. Dep. NTIS.

The results of physics tests performed on PWR Core 2 Seed 2 from 4899 through 4937 equivalent full power hours of operation are presented. These tests provided information on critical rod positions, reactivity coefficients, and xenon transient characteristics. Measured results are compared with calculated data and with earlier test data for PWR Core 2 Seed 2 and PWR Core 2 Seed 1. The agreement between measured and calculated data was generally good. None of the test results obtained adversely affects current assessments of reactor lifetime, operational capability, or requirements for reactor protection. (auth)

27426 CONSTRUCTION OF A NUCLEAR POWER STATION WITH COMPRESSED WATER REACTOR AT BORSSELE. Schroeder, W. Polytech. Tijdschr., Elektrotech./Electron.; 26: No. 5, 173-81(3 Mar 1971). (In Dutch).

Described is a 470 MW nuclear power station constructed at Borssele, with a pressurized water reactor, having a thermal capacity of 1,365 MW, generated by 121 fuel elements. The uranium applied amounts to about 38 tons. (auth) (Netherlands)

27427 MAN AND ATOM. BUILDING A NEW WORLD THROUGH NUCLEAR TECHNOLOGY. Seaborg, Glenn T.; Corliss, William R. New York; E. P. Dutton and Company, Inc. (1971). 411p. $10.00.

The wide range of peaceful applications of nuclear energy are examined, and its potential for solving some of modern man's most pressing problems is discussed. Nuclear power plant operation is described, and some of the controversy surrounding nuclear power is examined. The future of fission and fusion power

is assessed, and the role of the atom in society is discussed. (H.D.R.)

Control and Instrumentation

Refer also to abstract 26010.

27428 (UJV–2106-R) CONCRETE PRESSURE VESSEL OF THE A-3 REACTOR. Stoces, B.; Burian, J.; Rataj, J. (Ceskoslovenska Akademie Ved, [Rez]. Ustav Jaderneho Vyzkumu). 1968. 19p. (In Czech). Dep. NTIS (U. S. Sales Only).

A brief review of the proposed inner reactor shield was made. The concept under consideration has been demonstrated in the French (Zoe) and English (Lido) reactors. Methods of calculating the heat generated are discussed, and the effects of radiation on the structural materials are considered. Additional measurements that need to be made include, for example, the effects of inhomogeneities. (TTT)

27429 EFFECT OF COOLANT GAS IMPURITIES AND FAST NEUTRON DOSE ON THE MATERIALS OF THE PRIMARY CIRCUIT OF THE AVR REACTOR. Nieder, R.; Ivens, G. (Arbeitsgemeinschaft Versuchs-Reaktor GmbH., Dusseldorf, Ger.). pp 179-86 of Effects of Environment on Material Properties in Nuclear Systems. /Hurrell, M. L. (ed.). London: Institution of Civil Engineers (1971).

From International conference on the effects of environment on material properties in nuclear systems; London, England (1 Jul 1971).

During 3 years of operations of the AVR power station (prototype high temperature reactor) the coolant gas impurities were found to have no harmful effect on the components of the primary circuit. The structure of the graphite of the fuel elements, however, changed due to neutron irradiation. This structure change hindered the emergence of the fission noble gases into the primary circuit. (5 references) (auth)

Operation and Economics

27430 (DOCKET-1155–165) LA CROSSE BOILING WATER REACTOR. Incident Report: Reactor All Rod Scram Due to Trips on Two Out of Four Nuclear Instrumentation Channels. (Dairyland Power Cooperative, La Crosse, Wis.). 30 Mar 1972. 3p. (DPC–72-3). Dep. NTIS.

27431 (DOCKET-1155–166) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report for January 1972. (Dairyland Power Cooperative, La Crosse, Wis.). 12 Apr 1972. Contract AT(11-1)-851. 48p. (DPC–851-39). Dep. NTIS.

27432 (DOCKET-50133–81) HUMBOLDT BAY POWER PLANT, UNIT 3. Malfunction of Propane Engine-Driven Generator. (Pacific Gas and Electric Co., San Francisco, Calif.). 3 Apr 1972. 2p. Dep. NTIS.

27433 (DOCKET-50146–105) SAXTON NUCLEAR EXPERIMENTAL REACTOR PROJECT. Action Taken to Correct Items of Noncompliance Listed in Letter of February 23, 1972. (Division of Compliance (AEC), Newark, N. J. Region I). 23 Mar 1972. 7p. Dep. NTIS.

Information is presented concerning personnel emergency procedures during high radioactivity conditions. (D.C.C.)

27434 (DOCKET-50155–107) BIG ROCK POINT NUCLEAR PLANT. Fifteenth Semiannual Report of Operations, Addendum 1. (Consumers Power Co., Jackson, Mich.). 5 Apr 1972. 2p. Dep. NTIS.

Additional information is presented concerning radioactivity levels in cooling systems during July to December 1971. (D.C.C.)

27435 (DOCKET-50171–101) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Technical Specification, Amendment 18. (Philadelphia Electric Co., Pa.). 11 Apr 1972. 5p. Dep. NTIS.

Revised technical specifications are presented concerning the addition of 25 grams of plutonium for the test fuel element No. 13. (D.C.C.)

27436 (DOCKET-50219–176) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Radwaste Outside Tank Activity. (Jersey Central Power and Light Co., Morristown, N. J.). 4 Apr 1972. 2p. Dep. NTIS.

27437 (DOCKET-50219–177) OYSTER CREEK NUCLEAR POWER PLANT UNIT 1. Diesel Fire Pump Starting Failure. (Jersey Central Power and Light Co., Morristown, N. J.). 7 Apr 1972. 1p. Dep. NTIS.

27438 (DOCKET-50220–87) NINE MILE POINT NUCLEAR STATION. Request for Relief From Technical Specifications While Inspecting Interior of Torus and Performing Control Rod Maintenance. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 5 Apr 1972. 2p. Dep. NTIS.

27439 (DOCKET-50237–226) DRESDEN NUCLEAR POWER STATION, UNIT 2. Diesel Failed to Start During a Surveillance Test. (Commonwealth Edison Co., Chicago, Ill.). 30 Mar 1972. 2p. Dep. NTIS.

27440 (DOCKET-50237–227) DRESDEN NUCLEAR POWER STATION, UNIT 2. "2C" Low Pressure Coolant Injection Pump Failed to Start During a Surveillance Test. (Commonwealth Edison Co., Chicago, Ill.). 3 Apr 1972. 2p. Dep. NTIS.

27441 (DOCKET-50245–121) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrences AO-72-5, AO-72-6, AO-72-9, and AO-72-10. (Millstone Point Co., Hartford, Conn.). 13 Mar 1972. 4p. Dep. NTIS.

Abnormal occurrences are described concerning the malfunction of the low pressure coolant injection system low pressure valve permissive switch, the tripping of main steam line isolation valves at valves lower than specified, and the malfunction of the cleanup auxiliary pump suction valve. (D.C.C.)

27442 (DOCKET-50245–123) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Startup Test Program Results. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Sep 1971. 204p. (NEDE–13201-A). Dep. NTIS.

27443 (DOCKET-50247–71) INDIAN POINT NUCLEAR GENERATING UNIT 2. Reactor Coolant System Pressure Surge. (Consolidated Edison Co. of New York, Inc., New York). 14 Apr 1972. 4p. Dep. NTIS.

27444 (DOCKET-50249–128) DRESDEN NUCLEAR POWER STATION, UNIT 3. Both Railroad Doors on Air Lock Left Open. (Commonwealth Edison Co., Cordova, Ill.). 27 Mar 1972. 1p. Dep. NTIS.

27445 (DOCKET-50249–129) DRESDEN NUCLEAR POWER STATION, UNIT 3. Failure of Torus Spray Isolation Valve 3-1501-19B to Open on Test. (Commonwealth Edison Co., Chicago, Ill.). 3 Apr 1972. 3p. Dep. NTIS.

27446 (DOCKET-50249–130) DRESDEN NUCLEAR POWER STATION, UNIT 3. Both Railroad Doors on the Unit 2/3 Air Lock Opened. (Commonwealth Edison Co., Chicago, Ill.). 5 Apr 1972. 1p. Dep. NTIS.

27447 (DOCKET-50254–73) QUAD-CITIES STATION, UNIT 1. Refueling Abnormal Occurrences. (Commonwealth Edison Co., Cordova, Ill.). 15 Mar 1972. 3p. Dep. NTIS.

Corrective maintenance for damaged relays associated with the reactor manual control system is described. The relays were damaged following a wiring error during modification procedures. (D.C.C.)

27448 (DOCKET-50254–74) QUAD-CITIES STATION, UNIT 1. Abnormal Occurrence 1-72-4, Water Hammer Damaged Spray System. (Commonwealth Edison Co., Cordova, Ill.). 5 Apr 1972. 1p. Dep. NTIS.

Water hammer damage to a loop of the containment spray system is described. The damage occurred during a surveillance test. (D.C.C.)

27449 (DOCKET-50254–77) QUAD-CITIES STATION, UNITS 1 AND 2. Request Authority to Test Each Unit up to Full Power Rating and Under Certain Conditions to Operate at 500 MWe Until September 15, 1972. (Commonwealth Edison Co., Chicago, Ill.). 7 Apr 1972. 73p. (DOCKET-50265–61). Dep. NTIS.

27450 (DOCKET-50254–78) QUAD-CITIES STATION, UNIT 1. One Reactor Core Isolation Cooling System Found to be Inoperable. (Division of Reactor Licensing (AEC), Washington, D. C.). 11 Apr 1972. 1p. Dep. NTIS.

27451 (DOCKET-50254–79) QUAD-CITIES STATION, UNIT 1. Diesel Generator Failed to Operate Because of High Crankcase Pressure. (Commonwealth Edison Co., Cordova, Ill.). 14 Apr 1972. 2p. Dep. NTIS.

27452 (DOCKET-50272–24) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Notice of Receipt of Application for Facility Operating License. (Public Service Electric and Gas Co., Newark, N. J.). 7 Apr 1972. 2p. (DOCKET-50311–24). Dep. NTIS.

27453 (DOCKET-50369–20) McGUIRE NUCLEAR STATION, UNITS 1 AND 2. Application for Licenses, Amendment 11. (Duke Power Co., Charlotte, N. C.). 27 Sep 1971. 6p. (DOCKET-50370–19). Dep. NTIS.

Cost estimates for McGuire Power Reactor Units 1 and 2 are presented. (D.C.C.)

27454 (EUR–4738) GARIGLIANO NUCLEAR POWER PLANT. Annual Report, 1970. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). 11 Oct 1971. 110p. (In Italian). Dep. NTIS (U. S. Sales Only). EUR FB 150,-.

The period of activity of the Garigliano power plant from 1 March 1970 to 28 February 1971 is summarized. The total gross output of the plant during this period of operation was approximately 920 million kWh. The gross electric power produced from the beginning of commercial operation of the plant to 28 February 1971 was 6 600 million kWh. On 13 June 1970, at the end of the second cycle, the plant was shut down and remained out of service until 16 September 1970 for maintenance work and the reloading of the reactor with 72 new fuel elements, 60 of which were 2.3%-enriched uranium elements, four plutonium elements and eight partially irradiated uranium elements loaded at the end of the first cycle. By the end of the second cycle the fuel elements of the initial core had achieved an average power burn-up of 1 4000 MWd/t, with peaks of 18 900 MWd/t. The burn-up of the second core, consisting of both the uranium type and the mixed oxide type of element, was 7 150 MWd/t. On 13 June 1970, therefore, the burn-up of the 228 elements of the initial core totalled 13 700 MWd/t. During the shut-down, extensive inspection checks were carried out on the main items of the primary circuit. In particular, on the basis of the results of these inspections it was decided to grind away the defects found on the outer surface of pressure vessel nozzle No. 11. The outlet pipes in the pressure vessel head were also repaired. An extensive program of research on fuel was carried out to determine the elements responsible for the increase in the rate of fission gas release which occurred in the final period of operation, from 15 000 μCi/sec in February 1970 to 27 800 μCi/sec in June 1970. Following the start-up on 16 September, 1970, the power was reduced in October 1970 owing to the abnormal functioning of the feed regulation valve of secondary steam generator B. On 1 February 1971, during start-up, recirculation pump A tripped. Subsequent investigations showed extensive damage to the journal bearing and the motor stator. This fault led to a reduction in power of the plant (455 MW(t)) because of the higher vacuum in the reactor which had a direct effect on the critical thermal ratio. (auth)

27455 (NP–19175) OECD HALDEN REACTOR PROJECT. Eleventh Annual Report, 1970. (Organization for Economic Cooperation and Development, Paris (France). European Nuclear Energy Agency, Paris (France)). 147p. Dep. NTIS (U. S. Sales Only).

Operations and maintenance requirements for the Halden Boiling Reactor during 1970 are described. The development of an on-line computer control system is reviewed. Irradiation testing of fuel element assemblies is described. (D.C.C.)

Safety and Siting

27456 (DOCKET-50003–103) INDIAN POINT STATION, UNIT 1. Loss of Coolant Analysis. (Consolidated Edison Co. of New York, Inc., New York). Mar 1972. 124p. Dep. NTIS.

27457 (DOCKET-50003–104) INDIAN POINT STATION, UNIT 1. General Design Criteria Review for Full-Term Operating License DPR-5. (Consolidated Edison Co. of New York, Inc., New York). Apr 1972. 144p. Dep. NTIS.

Information is presented concerning quality assurance requirements and reactor protection systems. (D.C.C.)

27458 (DOCKET-50003–105) INDIAN POINT STATION, UNIT 1. Technical Specifications, Change 45. (Division of Reactor Licensing (AEC), Washington, D. C.). 31 Mar 1972. 2p. Dep. NTIS.

Revised technical specifications are presented concerning the maximum allowable control rod position deviation. (D.C.C.)

27459 (DOCKET-50029–170) YANKEE NUCLEAR POWER STATION. Technical Specifications, Changes and Additions to Proposed Change 96. (Yankee Atomic Electric Co., Westboro, Mass.). 10 Mar 1972. 19p. Dep. NTIS.

Revised technical specifications are presented concerning design characteristics of the emergency core cooling system, the trip circuit for the turbine, hydrogen control system for the containment system, and low power physics tests for Core 10. (D.C.C.)

27460 (DOCKET-50029–173) YANKEE NUCLEAR POWER STATION. Proposed Change 96, Supplement 4. (Yankee Atomic Electric Co., Westboro, Mass.). 30 Mar 1972. 3p. Dep. NTIS.

Additional information is presented concerning the performance requirements for the emergency core cooling system following a loss of coolant accident. (D.C.C.)

27461 (DOCKET-50029–174) YANKEE NUCLEAR POWER STATION. Technical Specifications, Proposed Change 96, Supplement 3. (Yankee Atomic Electric Co., Westboro, Mass.). 12 Apr 1972. 3p. Dep. NTIS.

Corrected information is presented concerning the temperature rating of Class F insulation for cables for motor operated valves in the containment system. (D.C.C.)

27462 (DOCKET-50029–175) YANKEE NUCLEAR POWER STATION. Technical Specifications, Change 97. (Division of Reactor Licensing (AEC), Washington, D. C.). 14 Apr 1972. 6p. Dep. NTIS.

Revised technical specifications are presented concerning the loading and operation of Core 10 with Zircaloy clad fuel elements, modifications for the emergency core cooling system, and modifications to the reactor protection system. (D.C.C.)

27463 (DOCKET-50133–82) HUMBOLDT BAY POWER PLANT, UNIT 3. Mechanical Properties of Irradiated Reactor Material Surveillance Specimens. (Pacific Gas and Electric Co., San Francisco, Calif.). 7 Apr 1972. 12p. Dep. NTIS.

27464 (DOCKET-50133–83) HUMBOLDT BAY POWER PLANT, UNIT 3. Information Requested Regarding Possible Loss-Of-Coolant Accident. (Pacific Gas and Electric Co., San Francisco, Calif.). 6 Apr 1972. 3p. Dep. NTIS.

Requested information is presented concerning the effects of coolant loss accidents on safety related electrical equipment. (D.C.C.)

27465 (DOCKET-50146–106) SAXTON NUCLEAR EXPERIMENTAL REACTOR PROJECT. Decommissioning Plan and Safety Analysis Report. (Saxton Nuclear Experimental Corp., Pa.). 14 Apr 1972. 74p. Dep. NTIS.

27466 (DOCKET-50171–99) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Technical Specifications, Request for Change 16. (Philadelphia Electric Co., Pa.). 15 Mar 1972. 68p. Dep. NTIS.

Revised technical specifications are presented concerning design parameters and physics measurements for fuel test element FTE-13. (D.C.C.)

27467 (DOCKET-50213–137) HADDAM NECK PLANT, UNIT 1. Facility Description and Safety Analysis Report, Amendment 23. (Connecticut Yankee Atomic Power Co., Hartford). 24 Mar 1972. 57p. Dep. NTIS.

Revised and additional data are presented concerning design parameters and operations aspects of the reactor. (D.C.C.)

27468 (DOCKET-50219–175) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Technical Specifications, Change 10. (Division of Reactor Licensing (AEC), Washington, D. C.). 23 Mar 1972. 3p. Dep. NTIS.

A revised technical specification is presented to increase the radioactivity limit of liquid radioactive waste storage tanks outside the radwaste building. (D.C.C.)

27469 (DOCKET-50219–178) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Facility Change Request 2. (Jersey Central Power and Light Co., Morristown, N. J.). 6 Apr 1972. 10p. Dep. NTIS.

Nuclear characteristics for the Cycle 2 core are presented. (D.C.C.)

27470 (DOCKET-50237–224) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Technical Specifications, License DPR-19, Change 17; License DPR-25, Change 9. (Division of Reactor Licensing (AEC), Washington, D. C.). 17 Mar 1972. 12p. (DOCKET-50249–125). Dep. NTIS.

Revised technical specifications are presented concerning maintenance procedures for control elements. (D.C.C.)

27471 (DOCKET-50244–94) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Technical Specifications, Change 1. (Rochester Gas and Electric Corp., N. Y.). 30 Mar 1972. 4p. Dep. NTIS.

Revised technical specifications are presented concerning control rod bank insertion limits for revised core loading. (D.C.C.)

27472 (DOCKET-50245-124) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Inspection and Evaluation of Torus Baffles. (Millstone Point Co., Hartford, Conn.). 24 Mar 1972. 2p. Dep. NTIS.

27473 (DOCKET-50247-68) INDIAN POINT NUCLEAR GENERATING UNIT 2. Moisture Separator Reheater Drain System Modifications. (Consolidated Edison Co. of New York, Inc., New York). 27 Mar 1972. 6p. Dep. NTIS.

27474 (DOCKET-50247-70) INDIAN POINT NUCLEAR GENERATING UNIT 2. Correspondence Relative to Ten Inch Accumulator Check Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 16 Mar 1972. 10p. Dep. NTIS.

Information is presented concerning welding procedures and inspection requirements for accumulator check valves for the emergency core cooling system. (D.C.C.)

27475 (DOCKET-50250-81) TURKEY POINT PLANT, UNITS 3 AND 4. Steps Taken to Correct Items of Apparent Nonconformance in Letters Dated February 10, 1972 and February 24, 1972. (Division of Compliance (AEC), Atlanta, Ga. Region II). 22 Mar 1972. 10p. (DOCKET-50251-67). Dep. NTIS.

Additional information is presented concerning design parameters for modified safety relief valve headers for the main steam lines. (D.C.C.)

27476 (DOCKET-50254-75) QUAD-CITIES STATION, UNITS 1 AND 2. Facility Operating Licenses DPR-29 and DPR-30, Amendment 2. (Division of Reactor Licensing (AEC), Washington, D. C.). 31 Mar 1972. 26p. (DOCKET-50265-59). Dep. NTIS.

The operating license for power levels up to 502 MW(t) is presented. Additional information concerning thermal discharges from the reactors is presented. (D.C.C.)

27477 (DOCKET-50254-76) QUAD-CITIES STATION, UNITS 1 AND 2. Technical Specifications, Proposed Change. (Commonwealth Edison Co., Chicago, Ill.). 7 Apr 1972. 5p. (DOCKET-50265-60). Dep. NTIS.

Revised technical specifications are presented concerning the lowering of the turbine control system oil pressure scram setpoint to 900 psig. (D.C.C.)

27478 (DOCKET-50259-44) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1 AND 2. Application for Construction Permit, Additional Information Requested Regarding Financial Qualifications. (Tennessee Valley Authority, Chattanooga). 1 Feb 1967. 6p. (DOCKET-50260-41). Dep. NTIS.

27479 (DOCKET-50261-90) H. B. ROBINSON UNIT 2. Technical Specifications, Change 7. (Division of Reactor Licensing (AEC), Washington, D. C.). 30 Mar 1972. 4p. Dep. NTIS.

Revised technical specifications are presented concerning modification of the diesel generator protective trip circuits and the test requirements for control rod drive trip breakers. (D.C.C.)

27480 (DOCKET-50267-40) FORT ST. VRAIN NUCLEAR GENERATING STATION. Draft Environmental Statement Related to Proposed Issuance of an Operating License. (Division of Reactor Licensing (AEC), Washington, D. C.). Apr 1972. 172p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Biological, geological, and hydrological data from the reactor site are included. Financial aspects of reactor operations are presented. (D.C.C.)

27481 (DOCKET-50269-50) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Environmental Statement. (Division of Radiological and Environmental Protection (AEC), Washington, D. C.). Mar 1972. 379p. (DOCKET-50270-41; DOCKET-50287-37). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. Biological and meteorological data on the reactor site are included. Cost-benefit analysis for reactor operation is presented. (D.C.C.)

27482 (DOCKET-50271-77) VERMONT YANKEE NUCLEAR POWER STATION. Draft Detailed Statement on Environmental Considerations. (Division of Radiological and Environmental Protection (AEC), Washington, D. C.). 7 Apr 1972. 237p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Biological, geological, and hydrological data for the reactor site are included. Environmental aspects of transmission lines are described. Cost-benefit analysis of reactor operations is presented. (D.C.C.)

27483 (DOCKET-50277-45) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Final Safety Analysis Report, Amendment 15. (Philadelphia Electric Co., Pa.). 3 Apr 1972. 47p. (DOCKET-50278-35). Dep. NTIS.

Revised information is presented concerning the pre-operational test program. Included also are requested additional data on the reactor cooling system and containment system. (D.C.C.)

27484 (DOCKET-50280-73) SURRY POWER STATION, UNITS 1 AND 2. Steps Taken to Correct Items of Noncompliance in Inspections of December 2-3, 1971 and January 25-28, 1972. (Division of Compliance (AEC), Atlanta, Ga. Region II). 17 Mar 1972. 8p. (DOCKET-50281-70). Dep. NTIS.

Information is presented concerning heat treatments for welds in cooling system feedwater piping. (D.C.C.)

27485 (DOCKET-50281-71) SURRY POWER STATION, UNIT 2. Notice of Consideration of Issuance of Facility Operating License. (Division of Reactor Licensing (AEC), Washington, D. C.). 20 Mar 1972. 5p. Dep. NTIS.

27486 (DOCKET-50282-52) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Additional Comments Regarding Item of Apparent Noncompliance in Letter of January 14, 1972. (Division of Compliance (AEC), Glen Ellyn, Ill. Region III). 30 Mar 1972. 9p. (DOCKET-50306-50). Dep. NTIS.

Additional information is presented concerning quality assurance requirements for steam generator structural steel supports. (D.C.C.)

27487 (DOCKET-50282-53) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Steps Taken to Correct Items of Apparent Nonconformance Listed in Letter of February 29, 1972. (Division of Compliance (AEC), Glen Ellyn, Ill. Region III). 4 Apr 1972. 7p. (DOCKET-50306-51). Dep. NTIS.

Additional information is presented concerning the installation of electrical cables. (D.C.C.)

27488 (DOCKET-50286-43) INDIAN POINT NUCLEAR GENERATING UNIT 3. Final Facility Description and Safety Analysis Report, Amendment 16. (Consolidated Edison Co. of New York, Inc., New York). 3 Apr 1972. 128p. Dep. NTIS.

Revised design parameters of the Indian Point Power Reactor Unit 3 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

27489 (DOCKET-50289-55) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Final Safety Analysis Report, Amendment 25. (Metropolitan Edison Co., Reading, Pa.). 6 Apr 1972. 45p. Dep. NTIS.

Revised and additional data are presented concerning design parameters and operations aspects of the Three Mile Island Power Reactor Unit 1. (D.C.C.)

27490 (DOCKET-50293-67) PILGRIM NUCLEAR POWER STATION. Final Safety Analysis Report, Amendment 32. (Boston Edison Co., Mass.). 7 Apr 1972. 184p. Dep. NTIS.

Revised and additional data are presented concerning design parameters and operations aspects of the Pilgrim Power Reactor. (D.C.C.)

27491 (DOCKET-50295-44) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Steps Taken to Correct Certain Items of Nonconformance Listed in Letter of February 7, 1972. (Division of Compliance (AEC), Glen Ellyn, Ill. Region III). 27 Mar 1972. 10p. (DOCKET-50304-44). Dep. NTIS.

Additional information is presented concerning the wall thickness of Class 1 valves, electrical cable installation, and battery room ventilation system. (D.C.C.)

27492 (DOCKET-50295-45) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Additional Comments Related to Items of Apparent Noncompliance Identified in Letter of February 28, 1972. (Division of Compliance (AEC), Glen Ellyn, Ill. Region III). 4 Apr 1972. 18p. (DOCKET-50304-45). Dep. NTIS.

Additional information is presented concerning quality assurance procedures, installation of electrical system, battery room ventilation system, instrumentation piping, Class 1 valve wall thicknesses, and evaluation of drop damage to a pressurizer. (D.C.C.)

27493 (DOCKET-50295–46) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Environmental Report, Supplement 4. (Commonwealth Edison Co., Chicago, Ill.). 13 Apr 1972. 30p. (DOCKET-50304–46). Dep. NTIS.

Additional information is presented concerning chemical, radioactive, and thermal discharges from the reactors. The effects of reactor operations on the environment are analyzed. (D.C.C.)

27494 (DOCKET-50298–28) COOPER NUCLEAR STATION. Steps Taken to Correct Items of Noncompliance Listed in Letter of February 11, 1972. (Division of Compliance (AEC), Denver, Colo. Region IV). 31 Mar 1972. 15p. Dep. NTIS.

Additional information is presented concerning wall thickness measurements for safety valves, hydrogen accumulation in battery room areas, steam line pressure relief valve position in the torus, preoperational testing, cooling system recirculation inlet nozzle repair, construction procedures, installation of electrical cables, and pressure vessel welding procedures. (D.C.C.)

27495 (DOCKET-50298–29) COOPER NUCLEAR STATION. Evaluation of Blow-Down Forces Scheduled for Completion June 30, 1972. (Nebraska Public Power District, Columbus). 30 Mar 1972. 2p. Dep. NTIS.

The program for evaluating the blowdown forces on the torus structural components and vent pipe anchorages is described. (D.C.C.)

27496 (DOCKET-50302–38) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Certain Activities Appear to be in Noncompliance. (Division of Compliance (AEC), Atlanta, Ga. Region II). 24 Nov 1972. 4p. Dep. NTIS.

Noncompliance with AEC regulations is described for the inspection and storage requirements for cooling system components, and for standards relating to cooling system check valve. (D.C.C.)

27497 (DOCKET-50302–39) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Application for Licenses, Amendment 16. (Florida Power Corp., St. Petersburg). 24 Mar 1972. 69p. Dep. NTIS.

Financial data for the Florida Power Corporation are presented. (D.C.C.)

27498 (DOCKET-50302–40) CRYSTAL RIVER NUCLEAR PLANT, UNIT 3. Final Safety Analysis Report, Amendment 17. (Florida Power Corp., St. Petersburg). 10 Apr 1972. 534p. Dep. NTIS.

Revised design parameters of the Crystal River Power Reactor Unit 3 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

27499 (DOCKET-50305–35) KEWAUNEE NUCLEAR POWER PLANT. Information Related to Item of Apparent Nonconformance in Letter of February 16, 1972. (Division of Compliance (AEC), Glen Ellyn, Ill. Region III). 15 Mar 1972. 6p. Dep. NTIS.

Additional information is presented concerning quality assurance procedures. (D.C.C.)

27500 (DOCKET-50313–40) ARKANSAS NUCLEAR ONE, UNIT 1. Final Safety Analysis Report, Amendment 25. (Arkansas Power and Light Co., Little Rock). 31 Mar 1972. 331p. Dep. NTIS.

Revised and additional data are presented concerning the design parameters and operations aspects for the Arkansas Nuclear One Power Reactor. Technical specifications are also included. (D.C.C.)

27501 (DOCKET-50315–59) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Comments on Apparent Item of Nonconformance Noted in Letter of February 28, 1972. (Division of Compliance (AEC), Glen Ellyn, Ill. Region III). 27 Mar 1972. 6p. (DOCKET-50316–59). Dep. NTIS.

Additional information is presented concerning radiographic inspection procedures for the pressure vessel. (D.C.C.)

27502 (DOCKET-50315–61) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 21. (Indiana and Michigan Power Co., New York). 15 Apr 1972. 247p. (DOCKET-50316–61). Dep. NTIS.

Revised design parameters of the Donald C. Cook Power Reactor Units 1 and 2 are presented. Included also are additional data on the reactors requested by the Division of Reactor Licensing. (D.C.C.)

27503 (DOCKET-50317–44) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Notice of Consideration of Issuance of Facility Operating Licenses and Notice of Opportunity for Hearing. (Division of Reactor Licensing (AEC), Washington, D. C.). 20 Mar 1972. 6p. (DOCKET-50318–43). Dep. NTIS.

27504 (DOCKET-50317–45) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Site Emergency Plan. (Baltimore Gas and Electric Co., Md.). 14 Apr 1972. 134p. (DOCKET-50318–44). Dep. NTIS.

27505 (DOCKET-50321–34) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Transmittal of Procedures for Removal of Ultrasonic Reflectors. (Georgia Power Co., Atlanta). 20 Mar 1972. 220p. Dep. NTIS.

Procedures for the removal of ultrasonic reflectors in the pressure vessel for the Edwin I. Hatch Power Reactor Unit 1 are presented. (D.C.C.)

27506 (DOCKET-50321–35) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Final Safety Analysis Report, Amendment 13. (Georgia Power Co., Atlanta). 27 Mar 1972. 232p. Dep. NTIS.

Revised design parameters of the Edwin I. Hatch Power Reactor Unit 1 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

27507 (DOCKET-50321–36) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Response to Letter of March 28, 1972 Transmitting Comments of Fish and Wildlife Service to Final Safety Analysis Report. (Georgia Power Co., Atlanta). 29 Mar 1972. 11p. Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the Altamaha River aquatic life are studied. (D.C.C.)

27508 (DOCKET-50333–40) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendment 6. (Power Authority of the State of New York). 29 Mar 1972. 266p. Dep. NTIS.

Revised design parameters of the James A. Fitzpatrick Power Reactor are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

27509 (DOCKET-50336–32) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 2. Action Taken to Correct Item of Nonconformance Identified in Letter of February 16, 1972. (Division of Compliance (AEC), Newark, N. J. Region I). 17 Mar 1972. 6p. Dep. NTIS.

Information is presented concerning qualification test requirements for welders for construction of the Millstone Point Power Reactor Unit 2. (D.C.C.)

27510 (DOCKET-50338–42) NORTH ANNA POWER STATION, UNITS 1, 2, 3, AND 4. Applicant's Environmental Report Supplement, Amendment 1. (Virginia Electric and Power Co., Richmond). 20 Mar 1972. 8p. (DOCKET-50339–40; DOCKET-50404–11; DOCKET-50405–11). Dep. NTIS.

Maps of transmission lines rights-of-way are presented. (D.C.C.)

27511 (DOCKET-50358–34) WILLIAM H. ZIMMER NUCLEAR POWER STATION, UNIT 1. Steps Taken to Correct Items of Apparent Inconsistencies and Noncompliance in Letter of February 29, 1972. (Division of Compliance (AEC), Glen Ellyn, Ill. Region III). 9 Mar 1972. 8p. Dep. NTIS.

Additional information is presented concerning quality assurance procedures and requirements. (D.C.C.)

27512 (DOCKET-50361–21) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Preliminary Safety Analysis Report, Amendment 11. (Southern California Edison Co., Rosemead, Calif.). 30 Mar 1972. 371p. (DOCKET-50362–20). Dep. NTIS.

Geological and seismological data for the reactor site are presented. Soil properties for the reactor site are also included. (D.C.C.)

27513 (DOCKET-50363–22) FORKED RIVER NUCLEAR POWER STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 14. (Jersey Central Power and Light Co., Morristown, N. J.). 7 Apr 1972. 159p. Dep. NTIS.

Revised design parameters of the Forked River Power Reactor Unit 1 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

27514 (DOCKET-50366–24) EDWIN I. HATCH NUCLEAR PLANT, UNIT 2. Comments on Fish and Wildlife Service Recommendation Regarding Environmental Monitoring Service. (Georgia Power Co., Atlanta). 29 Mar 1972. 7p. Dep. NTIS.

Information concerning radioactive and thermal discharges from

the reactor is presented. The effects of reactor operations on the Altamaha River aquatic life are studied. (D.C.C.)

27515 (DOCKET-50368-25) ARKANSAS NUCLEAR ONE, UNIT 2. Environmental Report, Supplement 2. (Arkansas Power and Light Co., Little Rock). 5 Apr 1972. 113p. Dep. NTIS.

Revised and additional data are presented concerning chemical, radioactive, and thermal discharges from the reactor. The effects of reactor operations on the environment are analyzed. (D.C.C.)

27516 (DOCKET-50373-18) LA SALLE COUNTY STATION, UNITS 1 AND 2. Environmental Report, Supplement 5. (Commonwealth Edison Co., Chicago, Ill.). 3 Apr 1972. 35p. (DOCKET-50374-18). Dep. NTIS.

Information is presented concerning site layout and thermal discharges from the reactors. (D.C.C.)

27517 (DOCKET-50376-30) AGUIRRE NUCLEAR PLANT, UNIT 1. Preliminary Facility Description and Safety Analysis Report, Amendment 16. (Puerto Rico Water Resources Authority, San Juan). 7 Apr 1972. 121p. Dep. NTIS.

Revised and additional data are presented concerning engineered safeguards, instrumentation, and safety analysis. (D.C.C.)

27518 (DOCKET-50382-20) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Preliminary Safety Analysis Report, Amendment 13. (Louisiana Power and Light Co., New Orleans). 24 Mar 1972. 57p. Dep. NTIS.

Revised design parameters of the Waterford Power Reactor Unit 3 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

27519 (DOCKET-50390-11) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 5. (Tennessee Valley Authority, Chattanooga). 22 Mar 1972. 415p. (DOCKET-50391-11). Dep. NTIS.

Revised design parameters of the Watts Bar Power Reactor Units 1 and 2 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

27520 (DOCKET-50390-12) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Draft Environmental Statement, Supplements and Additions. (Tennessee Valley Authority, Chattanooga). 11 Apr 1972. 183p. (DOCKET-50391-12). Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. Environmental aspects of transmission lines are described. Financial data concerning reactor operations are included. (D.C.C.)

27521 (DOCKET-50395-16) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Department of Justice Sees No Need for an Antitrust Hearing. (Department of Justice, Washington, D. C. Antitrust Div.). 31 Mar 1972. 10p. Dep. NTIS.

27522 (DOCKET-50397-14) HANFORD NO. 2 NUCLEAR POWER PLANT. Environmental report, Amendment 2. (Washington Public Power Supply System, Richland). 24 Mar 1972. 135p. Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

27523 (DOCKET-50398-10) MENDOCINO POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 4. (Pacific Gas and Electric Co., San Francisco, Calif.). 4 Apr 1972. 157p. (DOCKET-50399-10). Dep. NTIS.

Revised design parameters of the Mendocino Power Reactor Units 1 and 2 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

27524 (DOCKET-50400-15) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Preliminary Safety Analysis Report, Amendment 6. (Carolina Power and Light Co., Raleigh, N. C.). 31 Mar 1972. 162p. (DOCKET-50401-15; DOCKET-50402-15; DOCKET-50403-15). Dep. NTIS.

Revised and additional data are presented concerning design parameters and operations aspects for the Shearon Harris Power Reactor Units 1, 2, 3, and 4. (D.C.C.)

27525 (DOCKET-50400-16) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Preliminary Safety Analysis Report, Amendment 7. (Carolina Power and Light Co., Raleigh, N. C.). 4 Apr 1972. 154p. (DOCKET-50401-16; DOCKET-50402-16; DOCKET-50403-16). Dep. NTIS.

Requested additional information is presented concerning design parameters and operations aspects of the reactors. (D.C.C.)

27526 (DOCKET-50404-12) NORTH ANNA POWER STATION, UNITS 3 AND 4. Report, Foundation Investigation. Virginia Electric and Power Co., Richmond). 28 Mar 1972. 123p. (DOCKET-50405-12). Dep. NTIS.

27527 (KFK-1511) CONTRIBUTION TO THE ANALYSIS OF THE ALLOWABLE POWER STATION POPULATION OF THE RHINE WITH RESPECT TO THE THERMAL LOAD. Jansen, P.; Schikarski, W.; Stehfest, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Dec 1971. 30p. (In German). Dep. NTIS (U. S. Sales Only).

The population of the Rhine with power stations is examined in light of the most important parameters. These are: the maximum permissible water temperature, T_{max}; the maximum permissible increase in temperature, ΔT_{max}, relative to the natural water temperature; the desired average power yield of the power stations; their efficiency; and the meteorological data of consequence for the natural cooling of the river. The results show that realistic values of ΔT_{max} for $T_{max} > 20°C$ has little effect on the permissible level of power production along the Rhine. They show further that natural cooling effects, while uncertain in magnitude, have little effect on this level. For a temperature increase of 3°C, a power yield of approximately 80% and a thermal efficiency of 32% the permissible level of electric power production along the Rhine is found to be 12 GW(e). For an increase of 5°C the respective value is 21 GW(e). (auth)

27528 SELECTED MATERIALS ON THE CALVERT CLIFFS DECISION, ITS ORIGIN, AND AFTERMATH. JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETY-SECOND CONGRESS, FIRST SESSION, FEBRUARY 1972. Washington, D. C.; Joint Committee on Atomic Energy (1972). 681p. GPO $2.75.

Propulsion and Auxiliary Power Reactors

Refer also to abstracts 25424 and 25503.

27529 (ACF-403-1) KIWI-A REACTOR ASSEMBLY WEIGHT BREAKDOWN. (ACF Industries, Inc., Albuquerque, N. Mex.). 24 Mar 1959. Contract AT(29-1)-1352. 11p. Dep. NTIS.

Declassified 29 Oct 1971.

Values of weight, volume, and center of gravity locations are presented for the various components and sections of the KIWI-A Reactor. (H.D.R.)

27530 (ACF-403-15) KIWI-A' AND A3: REACTOR AND CAR ASSEMBLY PROCEDURE. (ACF Industries, Inc., Albuquerque, N. Mex.). [nd.]. 35p. Dep. NTIS.

Declassified 1 Nov 1971.

A procedure manual is presented as a guide to the assembly of the KIWI-A-Prime Reactor and test car at the Nuclear Rocket Development Station. (H.D.R.)

27531 (ACF-403-29) KIWI-A' AND A3 REACTOR DISASSEMBLY PROCEDURE. (ACF Industries, Inc., Albuquerque, N. Mex.). [1960]. 28p. Dep. NTIS.

Declassified 29 Oct 1971.

A chronological guide to post-test disassembly of the KIWI-A-Prime and KIWI-A3 reactors is presented. (H.D.R.)

27532 (ACF-403-35) KIWI-A3: POST-MORTEM PROCEDURE. (ACF Industries, Inc., Albuquerque, N. Mex.). 2 Sep 1960. 29p. Dep. NTIS.

Declassified 29 Oct 1971.

A chronological listing of post-test procedures to be carried out on the KIWI-A3 Reactor is presented. (H.D.R.)

27533 (ACF-403-48) KIWI-B-1A REACTOR AND CAR ASSEMBLY PROCEDURE. (ACF Industries, Inc., Albuquerque, N. Mex.). 1 Sep 1961. Contract [AT(29-1)-1352]. 79p. Dep. NTIS.

Declassified 28 Oct 1971.

A general guide for step-by-step construction of the KIWI-B-1A Reactor and transport car at the Nevada Test Site is presented. The manual covers the assembly of the reactor to the test car and

the installation of all remaining component parts and experimental devices. (H.D.R.)

27534 (ACF–431–8) KIWI-B-4A REACTOR AND CAR ASSEMBLY PROCEDURE. (ACF Industries, Inc., Albuquerque, N. Mex.). 31 Aug 1962. Contract AT(29-1)-1352. 83p. Dep. NTIS.

Declassified 28 Oct 1971.

A procedural manual is presented as a step-by-step guide for the assembly of the KIWI-B-4A Reactor and test car at the Nevada Test Site. (H.D.R.)

27535 (ACF–431–9) KIWI-B-1B REACTOR AND CAR ASSEMBLY PROCEDURE. (ACF Industries, Inc., Albuquerque, N. Mex.). 28 May 1962. Contract AT(29-1)-1352. 71p. Dep. NTIS.

Declassified 29 Oct 1971.

A procedural manual is presented as a step-by-step guide for the assembly of the KIWI-B-1B Reactor and test car at the Nevada Test Site. (H.D.R.)

27536 (ACF–431–23) KIWI B-1B NTS POST-MORTEM PROCEDURE. (ACF Industries, Inc., Albuquerque, N. Mex.). 20 Aug 1962. Contract [AT(29-1)-1352]. 54p. (FTR–1499). Dep. NTIS.

Declassified 1 Nov 1971.

A guide is presented to assist in post-test information gathering on the KIWI-B-1B Reactor. The guide contains charts and tables to aid the operator in obtaining data, forms upon which to record data, and the chronological order of operations. (H.D.R.)

27537 (ACF–431–65) KIWI B4D-CF REACTOR ASSEMBLY PROCEDURE. (ACF Industries, Inc., Albuquerque, N. Mex.). 9 Dec 1963. Contract AT(29-1)-1352. 212p. Dep. NTIS.

Declassified 28 Oct 1971.

A guide to the assembly of the KIWI-B4D-CF Reactor at the Nuclear Rocket Development Station is presented. Included are step-by-step procedures for assembly of the component parts and detailed inspection criteria for the assembled parts. (H.D.R.)

27538 (AEC-W0–519) PROPOSAL FOR AUXILIARY POWER PLANT FOR ADVANCED RECONNAISSANCE SYSTEM. (Westinghouse Air Brake Co., Pittsburgh, Pa.). 15 Oct 1955. 132p. Dep. NTIS.

Declassified 2 Nov 1971.

A program to develop and demonstrate the feasibility of an auxiliary power plant unit for a reconnaissance satellite is presented. The proposed power plant is a gas cooled epithermal reactor with a calcium hydride moderator. Helium will be used in a single phase Rankine cycle to operate a composite heat engine-compressor unit which will drive an induction generator. The power output will be 3 kW(e). (H.D.R.)

27539 (AEC-WO–355-L(Pt.1)) JOB 872: DESIGN CRITERIA, INITIAL ENGINE TEST AREA. (Parsons-Macco-Kiewit Co., Los Angeles, Calif.). 28 Mar 1952. Contract AT(11-1)-171. 66p. Dep. NTIS.

Declassified 27 Oct 1971.

Design criteria are presented for: (1) initial engine test building; (2) control building; (3) filter building; and (4) equipment building. (H.D.R.)

27540 (AI–8576(Vol.3)) STUDY OF SNAP POWER SYSTEMS IN THE LUNAR ENVIRONMENT: STUDY SUMMARY. VOLUME 3. Ackermann, W. O. Jr.; Wimmer, R. E.; Howard III, W. B.; Bilibin, K. (Atomics International, Canoga Park, Calif.). 8 Sep 1964. Contract NAS-3-2530. 171p. Dep. NTIS.

Declassified 5 Nov 1971.

A preliminary analysis of a nominal 50-kW electric power plant, capable of operation for at least one year in the lunar environment and utilizing SNAP 8 components to the maximum practical extent is presented. Two basic design concepts were analyzed. The first concept involved lunar burial of the reactor for shielding, and deployment of the radiator assemblies. A direct-condensing mercury radiator is used. The basic 50-kW design, including fluid inventories, has a weight of 6500 to 8500 lb, depending on the meteoroid protection criteria used. The 10 mrem/hr exclusion radius for this design is about 10 ft. The second design concept, the "integral" design, uses an earth-fabricated shield and operates essentially in the "as-landed" configuration. Indirect NaK radiators were used, and the net electric output is 44 kW. Total payload weight is 25,000 lb. Meteoroid shielding criteria again determine the weight of the plant, and the balance available for shielding and shield structure ranges between 9300 and 16,000 lb. The operating exclusion radius (at 10 mrem/hr) then ranges from 5000 to 1900 ft. 11 references. (auth)

27541 (AI-Memo–5642) PRELIMINARY DESIGN OF A TRANSPORTABLE 2 MEGAWATT ELECTRICAL NUCLEAR POWER SYSTEM. (Atomics International, Canoga Park, Calif.). 10 Sep 1960. 54p. Dep. NTIS.

Declassified 8 Apr 1971.

A preliminary design is presented for a 2 MW(e) power plant transportable in 3 modules. The reactor core is fueled and moderated with U–ZrH elements and cooled with a forced-circulation boiling water system directly connected to a turbo-generator. A development program plan is proposed for the power plant. (H.D.R.)

27542 (APEX–728) P122C1 AND P122C3 ANALYTICAL PERFORMANCE EVALUATION SUMMARY. Motsinger, R. E. (ed.) (General Electric Co., Cincinnati, Ohio. Flight Propulsion Lab. Dept.). Sep 1961. Contract AT(11-1)-171. 159p. Dep. NTIS.

Declassified 29 Oct 1971.

The status of the folded flow program at the time of the contract termination is given in terms of design and analysis results, including power plant and component drawings, performance and weight objectives; and, analyses results in areas of stress, nuclear, and aerothermal. Coverage is given to the P122C1 subsonic and to the P122C3 supersonic versions of folded flow application. Indications were that the P122C1 design objectives would be met within about five percent in terms of power plant weight, and that the effect of this discrepancy on airplane performance was essentially negligible. However, radiation dose levels to the side of the shield were in excess of limits established for the D140E predecessor power plant. (auth)

27543 (CNLM–3682(Suppl.1)) PROBLEMS ASSOCIATED WITH THE DESIGN AND DEVELOPMENT OF THE LITHIUM COOLED REACTOR FOR THE 1 Mwe SPACE POWERPLANT. Perry, P. I. (Pratt and Whitney Aircraft, Middletown, Conn, Connecticut Advanced Nuclear Engineering Lab.). 21 Jun 1961. Contract [AT(30-1)-2789]. 3p. Dep. NTIS.

Declassified 4 Nov 1971.

27544 (CNLM–5325(Vol.3)) PROPOSAL: SECOND GENERATION PORTABLE NUCLEAR POWERPLANT. VOLUME III. PHASE I DESIGN STUDY. (Pratt and Whitney Aircraft, Middletown, Conn, Connecticut Advanced Nuclear Engineering Lab. Stone and Webster Engineering Corp., [New York]). 15 Nov 1963. 10p. Dep. NTIS.

Declassified 5 Nov 1971.

The design arrangement, work plan, and cost estimate are presented for a portable liquid metal cooled power reactor. (H.D.R.)

27545 (CNLM–5325(Vol.4)) PROPOSAL: SECOND GENERATION PORTABLE NUCLEAR POWERPLANT. VOLUME IV. PROTOTYPE DEVELOPMENT PROGRAM. (Pratt and Whitney Aircraft, Middletown, Conn, Connecticut Advanced Nuclear Engineering Lab. Stone and Webster Engineering Corp., [New York]). [nd]. 35p. Dep. NTIS.

Declassified 5 Nov 1971.

Development activities, prototype design and construction, and prototype operations are proposed for a portable liquid metal cooled power reactor. (H.D.R.)

27546 (EUR–4630(Vol.2)) NUCLEAR-PROPELLED TANKER. Final Report. Fedrighini, A. (ed.) (Fiat, Turin (Italy). Sezione Energia Nucleare. Ansaldo S.p.A., Genoa (Italy)). 1972. 46p. (In Italian). Dep. NTIS (U. S. Sales Only). EUR FB 60,-.

The main bibliographical references used for the research and development program for a nuclear propelled tanker are summarized. (auth)

27547 (GULF-GA-A-10797) PARAMETRIC NEUTRONIC ANALYSIS OF THERMIONIC REACTORS WITH U–ZrH DRIVER FUEL. Merrill, M. H.; Hackney, M. R. (Gulf General Atomic Co., San Diego, Calif.). 15 Oct 1971. Contract AT(04-3)-840. 32p. Dep. NTIS.

A series of parametric nuclear calculations were done for a U–ZrH moderated thermionic reactor design. The critical size, thermal efficiency, control drum worth, and radial power distribution were determined as a function of the number of thermionic fuel elements, the emitter thickness, the control drum thickness, and the weight percent of uranium in the U–ZrH driver fuel. In addition to the direct numerical results, some simple correlations were derived for the critical size, thermal efficiency and control drum worth. (auth)

27548 (N–71–37377) THERMIONIC SPACECRAFT DESIGN STUDY, 120 kw NUCLEAR ELECTRIC PROPULSION SYSTEM. VOLUME 1. SUMMARY. Final Report. (General Electric Co., Philadelphia, Pa.). 30 Jun 1971. Contracts NAS7-100; JPL-952381. 76p. (NASA-CR–122928; GESP–648(Vol.1)). NTIS.

For Jet Propulsion Lab., Pasadena, Calif.

Electrically propelled spacecraft designs for a Comet Halley rendezvous mission, using thermionic reactors as the electrical power source, were investigated. Four spacecraft designs were prepared. The four spacecraft designs include two external-fuel reactor concepts providing 120 kW(e) at 40 V dc to the thrust subsystem and two internal-fuel reactor concepts (10 V dc and 40 V dc) providing 120 kW(e) to the thrust subsystem. The impact of integration with the space shuttle, the use of ^{233}U fueled reactors, alternate EM pumps and main radiator systems is assessed for each of the four spacecraft designs. The three 40 V dc spacecraft designs are nearly the same size (1.14 m diameter by 20 m to 22 m long) with specific weights from 26 to 30 kg/kW(e). The 10 V dc spacecraft design is 27 m long, with a specific weight of about 33 kg/kW(e). Integration into the space shuttle adds 2 kg/kW(e) to the 40 V dc spacecraft designs, and 6 kg/kW(e) to the 10 V dc spacecraft. The use of ^{233}U fueled reactors reduces the specific weight by 5 kg/kW(e) for a spacecraft design except the 10 V dc internal-fuel concept. (auth) (STAR)

27549 (N-71-38533) THERMIONIC SPACECRAFT DESIGN STUDY, 120 kw NUCLEAR ELECTRIC PROPULSION SYSTEM. VOLUME 2. EXTERNAL FUEL REACTOR SPACECRAFT DESIGN. Final Report. (General Electric Co., Philadelphia, Pa.). 30 Jun 1971. Contracts NAS7-100; JPL-952381. 101p. (NASA-CR-122927; GESP-648(Vol.2)). NTIS.

For Jet Propulsion Lab., Pasadena, Calif.

27550 (TM-62-6-7) SPECIFICATIONS FOR A FAST-SPECTRUM, REFRACTORY-METAL NUCLEAR REACTOR. Robertson, C. S. (General Electric Co., Cincinnati, Ohio. Flight Propulsion Lab. Dept.). 15 Jun 1962. 9p. Dep. NTIS.

Declassified 4 Nov 1971.

27551 PRESENT STATE OF RESEARCH ON NUCLEAR-POWERED SHIPS. Kataoka, Iwao (Ship Research Inst., Tokyo). Nippon Zosen Gakkaishi; No. 502, 204-12(Apr 1971). (In Japanese).

Existing nuclear ships in the world are outlined. Trends in improvement and development are reviewed. The following matters are described: increase of power density in light water reactor cores, increase in fuel burn-up, necessity for compact machines and instruments or their minimization, improvement in steam condition, improvement in primary system containment vessels, and development of shielding. Finally, development of gas-cooled ship propulsion reactors is examined. (Japan)

Control and Instrumentation

27552 (APEX-739) D140E1 RADIAL SHIELD AND PRESSURE VESSEL AEROTHERMAL ANALYSIS. Serkiz, A. W. (General Electric Co., Cincinnati, Ohio. Flight Propulsion Lab. Dept.). 6 Jul 1961. Contract AT(11-1)-171. 33p. Dep. NTIS.

Declassified 29 Oct 1971.

The termination status of the D140E1 Radial Shield and Pressure Vessel aerothermal analysis is presented. The status of analysis and design, design problems, and proposed solutions is summarized. Also listed are pertinent references. (auth)

27553 (APEX-741) FRONT SHIELD FABRICATION: XNJ140E-1. Fleming, John J. (General Electric Co., Cincinnati, Ohio. Flight Propulsion Lab. Dept.). 29 Jun 1961. Contract AT(11-1)-171. 45p. Dep. NTIS.

Declassified 29 Oct 1971.

The status of fabrication work and plans and manufacturing information are presented for the XNJ 140E-1 aircraft reactor front shield at the time of project termination. (H.D.R.)

27554 (APEX-742) REAR SHIELD FABRICATION. Fleming, John J. (General Electric Co., Cincinnati, Ohio. Flight Propulsion Lab. Dept.). 29 Jun 1961. Contract AT(11-1)-171. 44p. Dep. NTIS.

Declassified 29 Oct 1971.

The status of fabrication work and manufacturing instructions are presented for the XNJ 140E-1 aircraft reactor rear shield at the time of project termination. (H.D.R.)

27555 (BMI-1590) PARAMETRIC STUDY OF A RANKINE-CYCLE NUCLEAR SPACE-POWER SYSTEM. Egen, Richard A.; Hogan, William S.; Dingee, David A. (Battelle Memorial Inst., Columbus, Ohio). 3 Aug 1962. Contract W-7405-eng-92. 44p. Dep. NTIS.

Declassified 29 Oct 1971.

As an adjunct to an experimental program to develop fuel materials for advanced high-temperature reactors for nuclear space-power systems, an analytical program was developed to aid in the selection of materials and experimental conditions. The program provides guidance by indicating the effects of changes in fuel-material variables on powerplant characteristics. The material variables investigated included composition (coupled with cladding thickness), pin diameter, temperature, burnup, and fission-gas release. The effect of these variables as well as others (e.g., reactor thermal power) on the system specific weight (weight per unit electrical power) are determined for two fluid-loop, Rankine-cycle, fast-reactor powerplants of minimum specific weight. The analytical program was transcribed for use on a Bendix G-20 electronic digital computer. (auth)

Operation and Economics

27556 (CNLM-4373) [PRELIMINARY COST ESTIMATES OF REACTOR DEVELOPMENT, 1964-1968]. Doll, W. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 4 Jan 1963. 3p. Dep. NTIS.

Declassified 3 Nov 1971.

Preliminary cost estimates are presented for the LCRE, SNAP-50DR-1, SNAP-50 Power Conversion, SNAP-50 Powerplant, and the Advanced Materials Programs. (H.D.R.)

Safety

27557 (CNLM-3990) DESIGN CRITERIA FOR THE PWAR-16 REACTOR SAFETY SYSTEM. Naples, P. V. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 23 Feb 1962. Contract AT(30-1)-2789. 7p. Dep. NTIS.

Declassified 4 Nov 1971.

27558 (DOCKET-50238-89) N. S. SAVANNAH. Comments on Enclosure to Letter Dated November 9, 1971. (Maritime Administration, Washington, D. C.). 23 Nov 1971. 5p. Dep. NTIS.

Information is presented concerning emergency procedures for defueling. (D.C.C.)

27559 (DOCKET-50238-90) N. S. SAVANNAH. Comments Concerning Core II Applications. (Division of Reactor Licensing (AEC), Washington, D. C.). 4 Apr 1972. 3p. Dep. NTIS.

27560 (TIM-452) CTF SUMMARY HAZARDS REPORT. Hedden, D. T.; Macfarlane, D. B. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 15 Oct 1957. 150p. Dep. NTIS.

Declassified 19 Oct 1971.

The development of a nuclear power plant under the Aircraft Nuclear Propulsion Program required a facility for full-power reactor testing. Detailed design criteria were prepared for such a facility, called the Contained Test Facility (CTF). The various hazards that might conceivably be associated with aircraft reactor testing in the CTF are described. (H.D.R.)

Process Heat and Desalination Reactors

Operation and Economics

27561 INDUSTRIAL COMPLEX CENTERING AROUND NUCLEAR POWER GENERATION. Iwaki, Takayuki (Japan Gasoline Co. Ltd., Tokyo). Sekiyu To Sekiyu Kagaku; 15: No. 5, 38-47(Apr 1971). (In Japanese).

The general outlook of four models of an industrial complex with nuclear power reactors is described. The proposed models of the industrial complexes with nuclear power reactors are as follows: (1) manufacture of iron, chemical process, and power; (2) chemical process and power; (3) refining and power; (4) refining, chemical process, and power. (Japan)

Research and Test Reactors

Refer also to abstracts 27374, 27583, and 27607.

27562 (ANL-7882) EXPERIMENTAL RESULTS FOR ZPR-3 ASSEMBLIES 53 AND 54. Kaiser, R. E.; Gasidlo, J. M.; Lehto,

W. K.; Maddison, D. W.; Vosburgh, R. O.; Mountford, L. A. (Argonne National Lab., Ill.). Nov 1971. Contract W-31-109-eng-38). 58p. Dep. NTIS.

Assembly 53 was the fourth in a sequence of plutonium-fueled ZPR-3 benchmark assemblies with simple geometries and compositions. The objective of the sequence is to provide integral data for evaluating calculational methods and nuclear-data compilations to be used in the design of demonstration-plant liquid-metal fast breeder reactors. Assembly 54 was built to provide data related to the effect of uncertainties in the ^{238}U delayed-neutron parameters. The depleted-uranium blanket on Assembly 53 was removed and replaced with a mild steel reflector, thus greatly reducing the contribution of ^{238}U fission to the effective beta of the reactor system. The experimental program carried out in the two assemblies is described, including material-worth measurements, reactivity Doppler measurements, cell-heterogeneity determinations, and an evaluation of β/l by pulsed-neutron methods. In addition, the neutron-energy spectrum and spectral indices such as fission ratios and reaction-rate distributions were measured. (15 references) (auth)

27563 (GKSS-71/E/2) FRG-O-II EXPERIMENT. 4th Status Report, Status December 31, 1970. Apel, U.; Baumgart, R.; Boessow, E.; (and others) (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany). Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht (West Germany)). 1971. 79p. (In German). Dep. NTIS (U. S. Sales Only).

Experiments for the development of the FRG-2 were carried out. The maximum permitted power and reactivity values were determined for a nuclear charge without capsule positions. Reactivity values for plate trim rods of Cd and Ag–In–Cd (80-15-5) were measured. Thermal neutron spectrum, dependence of the reactivity value on the trim rod positon, and vertical thermal neutron flux distribution in the reflector were measured for the determination of the reactor physical properties of the FRG. The temperature coefficient of the reactivity was measured. Studies on the introduction of miniature fission chambers, construction of a multiscaler without battery, and reactivity comparison measurement were made for the improvement of the measurement techniques. 12 references. (tr-auth)

27564 (IJS-P-270) POWER NOISE ANALYSIS OF TRIGA REACTOR. Mavko, Borut (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Aug 1971. 71p. (In Slovenian). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Ljubljana Univ., Yugoslavia.

The measurements of power noise of the Triga reactor at Podgorica are described. Different inlet systems for the cooling water were used. Low frequency power noise was analyzed by autocorrelation functions, and power spectral densities were calculated. An attempt was made to describe the reactor system behavior by simulation on analog computer. 14 references. (auth)

27565 (JEN-223-DMe/I-23) TELEMACO: A COMPUTER PROGRAM FOR THE HYDRAULIC AND THERMIC STUDY OF FUEL ELEMENTS FOR A POOL REACTOR. AN APPLICATION TO THE JEN-1. Lopez Jimenez, J.; Garcia Ramirez, M. A.; Moneva Moneva, J. (Junta de Energia Nuclear, Madrid (Spain). Division de Metallurgia). 1970. 60p. (In Spanish). Dep. NTIS (U. S. Sales Only).

The FORTRAN IV computer program TELEMACO enables hydraulic and thermic calculations of fuel elements for a swimming pool type reactor working in steady state and monophasic flow. This program was specially aimed at the thermohydraulic study of an experimental fuel element placed in the reactor core. It allows the study of temperature fluctuations in the cladding, produced by variation of the channel geometry and local fuel content. The friction coefficients concerning the experimental fuel elements were determined in a water loop. Various types of cooling channels may be considered. Each channel is assumed to be thermally and hydraulically isolated from the others. By using the TELEMACO program several studies were carried out taking, as a base, the main parameters of the JEN-1 reactor, with the following lattices: (a) 1.5 mm thick, flat plates MTR fuel elements (10 plates per assembly); (b) 2.5 mm thick, flat plates MTR fuel (10 plates per assembly); (c) and (d) insertion in lattice (a) of a single MTR fuel assembly (2.5 mm thick plates) or insertion of one 4 × 4 rods (UO_2-Zircaloy) fuel assembly. (auth)

Control and Instrumentation

Refer also to abstracts 25442, 25443, and 27382.

27566 (AAEC/M-87) REACTOR HIFAR: SPACE CONDITIONER SYSTEM. Hopkinson, J. B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1971. 32p. Dep. NTIS (U. S. Sales Only).

The operating details for the Space Conditioner System of the reactor HIFAR are presented. The system was considerably modified during the latter half of 1970 and subsequently classified as an engineered safety feature. For the benefit of reactor operators a typical refrigeration circuit associated with the Space Conditioner System and an air conditioning process are briefly discussed. (auth)

27567 (JAERI-1213) WATER CHEMISTRY OF JMTR. Tone, Hirohito; Yamamoto, Katsumune; Okagawa, Seigo; Yokouchi, Iichiro; Atomura, Masakatsu (Japan Atomic Energy Research Inst., Oarai. Oarai Research Establishment). 16 Dec 1970. 30p. (In Japanese). Dep. NTIS (U. S. Sales Only).

Corrosion products, dissolved gases and fission products, especially radioiodine, were measured in JMTR primary coolant during the characteristic test of the reactor. Values were compared with those estimated in the design of JMTR; the estimations made were found to be adequate. The formation mechanism of ^{24}Na is also discussed. Radioiodine was detected in the primary coolant; it probably resulted from the surface contamination of fuel elements. (auth)

27568 (ORNL-TM-3460) HFIR WATER STRAINER. Abbatiello, A. A.; Fraas, A. P. (Oak Ridge National Lab., Tenn.). Mar 1972. Contract W-7405-eng-26. 17p. Dep. NTIS.

A strainer was designed, fabricated, and installed in the HFIR primary water coolant system to replace the original model, which had shown short life under the severe flow and vibration conditions. The new model is more rugged, being designed as two segments of a cylinder made of heavy perforated plate, and welded to give a tapered quasi conical shell with lenticular cross sections, and lined with heavy mesh screen. This construction permits adequate screen support with flow areas proportioned to minimize the pressure drop. This new model, in the relatively clean HFIR system, is expected to serve for the life of the reactor. The first of these strainers has outlasted three or four of the original types, and is giving excellent performance. Simulated proof tests, routine examinations, and a stress analysis are included. (auth)

27569 VERTICAL DRIVE CONTROL RODS ALRR (1 Dec 1971) (Engineering Materials). (Ames Lab., Iowa). (CAPE-2187).

14 drawings.

Redesigned vertical-drive control rods for the Ames Laboratory Research Reactor incorporate the drive package with position readouts and limit switches in the control-rod package, a different extensible conductor for magnet current, and a seat switch to assist in measuring drop times on the control rod. The control rod assembly is housed in an outer Al tube with a support flange at the top and a dashpot cylinder at the bottom. The control element and the external envelope are identical in size to the original. The control rod consists of three subassemblies or modular components which can be maintained individually with low radiation exposure. The modular components are the Cd section, magnet section, and the drive section. The Cd section has a stainless-steel follower which provides <1% $\Delta k/k$ more reactivity for all six rods as a maximum. To provide proper cooling, the Cd is jacketed with stainless steel. Shrink fit provides good thermal conduction and the welded construction is sealed to exclude D_2O. The Cd section is fitted into the piston for the dashpot shock absorber and welded. An extension tube fitted to the Cd section carries the pivoting-armature mount. A Ni-Fe alloy is used for the magnet, which is a hollow core, wound, and potted design which can operate in high humidity. Lifting is done by a screw assembly with the ball nut mounted on the top of the magnet. Guide rollers guide and prevent rotation when the magnet goes into the outer tube. The motor-drive package consists of limit switches, position readout, and low-range and rod-seat switches. The only maintenance requiring the removal of the entire control rod from the reactor occurs when anything needs to be done in the region of the dashpot on the Cd control section. (For details see TID-4100. Suppl 69) (F.S.)

27570 STUDIES ON THE SHIELDING OF THE ROSSENDORF RESEARCH REACTOR RFR IN CONNECTION WITH ITS POWER INCREASE FROM 4 UP TO 10 MWth. Adler, B.; Knobus, B.; Kneschke, J.; Wetzel, L. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 14: No. 12, 384-6(Dec 1971). (In German).

Studies of the radiation fields close to the RFR operated with a thermal power of 4 and 10 MW showed the shields of the RFR WWR-S reactor designed for 2 MW(t) and provided with some additions sufficient protection against the reactor radiation up to

10 MW(t). The fraction of neutron component of the total dose rate equivalent is 80 per cent on the average. (8 references) (auth)

Operation and Economics

27571 (DOCKET-50184-40) NATIONAL BUREAU OF STANDARDS REACTOR. Operations Report No. 12, July 1–December 31, 1971. (National Bureau of Standards, Washington, D. C.). 31 Mar 1972. 11p. Dep. NTIS.

Safety and Siting

27572 (DOCKET-50184-41) NATIONAL BUREAU OF STANDARDS REACTOR. Technical Specifications, Change 5. (Division of Reactor Licensing (AEC), Washington, D. C.). 4 Apr 1972. 5p. Dep. NTIS.

Revised technical specifications are presented concerning administrative personnel changes and the exemption of tritium from release limitations in primary coolant leaks. (D.C.C.)

27573 (DOCKET-50231-116) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Technical Specifications, Change 11. (Division of Reactor Licensing (AEC), Washington, D. C.). 11 Apr 1972. 8p. Dep. NTIS.

Revised technical specifications are presented concerning operating conditions and limits for the irradiated fuel storage tank. (D.C.C.)

27574 (JEN-222-DMe/I-22) STUDY OF TRANSIENT FLOW IN FUEL ELEMENT OF TUBULAR PLATES. Accident: Shaft Locking of Primary Cooling Pump Without Opening the Emergency Gate. Agullas, F.; Moneva, J.; Garcia Ramirez, M. A.; Lopez Jimenez, J.; Diaz Diaz, J. (Junta de Energia Nuclear, Madrid (Spain). Division de Metallurgia). 1971. 30p. (In Spanish). Dep. NTIS (U. S. Sales Only).

The thermal distribution of a fuel element of tubular plates irradiated in the JEN-1 reactor is analyzed in the case of shaft locking of the primary cooling pump without opening the emergency gate. The fuel element hottest channel is studied in the position of maximum neutronic flux for three reactor power levels: 3 MW (maximum reactor power), 2 MW and 1 MW. The results of the analysis of the transient flow for this accident show that the maximum temperature in the hottest point does not exceed 103°C. This temperature is lower than the boiling point of water (116°C) under the conditions of the system. 8 references. (auth)

27575 VACUUM SYSTEM FOR IRRADIATION STUDIES. Basham, S. J.; Zielenbach, W. J. (Battelle Memorial Inst., Columbus, Ohio). J. Vac. Sci. Technol.; 9: No. 1, 55-9(Jan-Feb 1972).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

An oil-free vacuum system capable of achieving vacuum levels of 10^{-6} torr for in-pile experiments has been constructed at the pool-type Battelle Research Reactor (BRR). The pumping system which is mounted on a moveable bridge above the pool surface, consists of a 7500-liter/sec titanium sublimation pump and two 350-liter/sec triode-type ion pumps; system roughing is accomplished with a roots-type blower with a double-walled liquid nitrogen trap. Nine meters of 20.3-cm dia vacuum piping connect the pumping system to a test chamber at the core level. Test chamber geometry can be varied to fit either a 7.62×7.62-cm test cell or the core face. Neutron fluxes of 2×10^{13} neutron/$cm^2 \cdot$ sec (thermal) and 1×10^{13} neutron/$cm^2 \cdot$ sec (fast) are available and the maximum gamma rate is 10^8 R/hr. Adjustments of desired gamma/neutron ratio are made by employing appropriate shielding at the core face. Irradiation effects on the performance of electromechanical components for space nuclear power systems have been studied at elevated temperatures (620 to 320°K) and a full-scale nuclear fueled thermionic diode is currently being prepared for irradiation in the system. (auth)

27576 SMALL ANGLE SCATTERING FACILITY AT THE BENT NEUTRON GUIDE OF THE COLD NEUTRON SOURCE AT THE FRJ-2. Schelten, J. (Institut fuer Festkoerperforschung, Juelich, Ger.). Kerntechnik; 14: No. 2, 86-8(Feb 1972). (In German and English).

The wide range of applications of small-angle scattering with neutrons and the required properties of an apparatus of this kind are discussed. The apparatus itself is described in detail. An experimental result obtained from measurements with Al–Zn is reported. (auth)

27577 TEMPERATURE FIELDS IN INSTALLATIONS BUILT INTO REACTORS. Stelzer, F.; Haas, H. (Kernforschungsanlage, Juelich, Ger.). Atomwirt., Atomtech.; 17: No. 4, 203-6(Apr 1972). (In German).

Mathematical procedures were developed for the solution of problems involving the thermal design of installations built into reactors, their assessment from a safety standpoint, and for evaluation of measuring data originating from these installations. The procedures permit the solution of direct as well as of inductive problems. For direct problems, the mathematical model is known and the potential field must be found; for inductive problems, the situation is reversed. Under direct problems, temperature fields in protruding bodies and in a cooled tube are treated. Under inductive problems, designs of reactor installations with specified temperature fields are analyzed. (H.B.G.)

Production Reactors

27578 (BNWL-135) ANALYSIS OF THE N REACTOR PRIMARY SHIELDS. Greenborg, J.; Berry, M. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sep 1965. Contract AT(45-1)-1830. 151p. Dep. NTIS.

Declassified 27 Oct 1971.

Neutron flux distribution in three groups (fast, epithermal and thermal) and gamma ray dose distribution in the N reactor reflector and primary shield were measured and compared to calculations. Agreement was within 10% for all neutron flux in the reflector, fast neutron flux and gamma ray dose in the shield. Agreement was within about a factor of two for thermal and epithermal flux in the shield. These distributions extend over a reduction in the flux of 10^{-8} for gamma radiation and 10^{-12} for fast neutron flux. Power normalized neutron fluxes were measured by absolute counting of irradiated sulfur, gold and cadmium covered gold foils. Gamma dose was measured with calibrated ion chambers. These detectors were spaced from the core-reflector interface to outside edge of the primary shield and were irradiated during the course of the reactor startup and power ascension tests. All power levels were known during irradiation providing absolute power normalization. The shield calculations were accomplished with the removal-diffusion theory code MAC (18 removal groups, 31 diffusion groups). Calculations were normalized to calculated core-reflector interface fission density based on measured core power distribution. Experimental data reduction and analytical procedures are discussed. (44 references) (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 25495, 25954, 25961, 25963, 25964, 25990, 25997, 26042, 26064, and 26066.

27579 (KFK-1477) TREATMENT OF THE MECHANICAL AND THERMAL RELATIONS OF FUEL RODS IN SATURN 1. Kaempf, H.; Elbel, H.; Depisch, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Nov 1971. 45p. (In German). (CONF-710903-10). Dep. NTIS (U. S. Sales Only).

From first international conference on structural mechanics in reactor technology; Berlin, Germany (20 Sep 1971).

In SATURN 1 the time history of a fuel pin concerning the radial distribution of temperature, stress, porosity and geometry changes is calculated. The operating fuel pin conditions such as linear rod power, outside temperature of the cladding and outside pressure are time dependent input data, so steady state and cyclic conditions are taken into account. The following material phenomena essential for the mechanical and thermal behavior are interconnected in SATURN 1: creep of fuel and clad, swelling of fuel and clad, thermal expansion, crack formation, fission gas release, porosity migration, and heat transfer fuel-clad. Three thermal-mechanical states are distinguished: fuel and clad in mechanical interaction, freestanding fuel and clad stressed by gas and coolant pressure, and freestanding stressed clad in contact or not in contact with cracked fuel assumed to be free of stresses. Three fuel zones are distinguished especially with view to different mechanical behavior. To demonstrate the manifold possibilities of SATURN 1 several illustrative applications are given. (6 references) (auth)

27580 (RDT-E-1-6-T(3-72)) AUTOMATIC SPRING-LOADED SAFETY VALVES. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Mar 1972. 36p. RSO.

Standards are presented for automatic, spring-loaded overpressure protection valves for use in water cooled power reactor system. (H.D.R.)

27581 (RDT-F-5-1-T(2-72)) CLEANING AND CLEANLINESS REQUIREMENTS FOR NUCLEAR COMPONENTS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Feb 1972. 18p. RSO.

Minimum requirements for cleaning and cleanliness during fabrication and assembly of vessels, heat exchangers, pumps, piping valves, and other components for nuclear service are presented. (auth)

27582 DYNAMIC SEAL. Ripley, Charles C. (to United States Atomic Energy Commission). U. S. Patent 3,640,845. 8 Feb 1972. Filed 9 Jul 1968.

A control rod drive system is described comprising basically a neutron absorbing control rod means defining a free floating piston, actuated by liquid sodium or other reactor coolant, a dynamic seal means and fluid valve means for moving said control rod. Said dynamic seal means constructed to prevent bypass of liquid metal, such as sodium, around the piston, and including a plurality of serially disposed skirts circumferentially arranged about the piston and sleeve and having lips directed toward the high-pressure end of the piston or sleeve, and also including circumferentially disposed toroidal grooves in the piston or sleeve between each of said skirts, whereby liquid metal from said high-pressure end is deflected by said lips of said skirts to circulate in said grooves and thus prevented from passing freely around said lips. In addition, any solid particles in the liquid metal are entrapped by the circulation in the grooves of the seal means. (Official Gazette)

27583 CAPSULE FOR IRRADIATION OF HIGH PERFORMANCE FUELS. Haefner, H. E.; Pinter-Kovats, G. (Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik; 14: No. 2, 72-4(Feb 1972). (In German and English).

An irradiation capsule was developed for the irradiation of carbide and nitride fuels at high temperatures (up to 2000°C) which is particularly suitable for the detection of changes in thermal conductivity of the fuel during irradiation and of changes in heat transfer in the gap between the fuel and the cladding. A brief description of the capsule and the results obtained so far in irradiation experiments on three rings are presented. (auth)

27584 COATED THERMOELEMENTS WITH BORON NITRIDE ISOLATION. Maiang, S. (Institut fuer Reaktorbauelemente, Karlsruhe, Ger.). Atomwirt., Atomtech.; 17: No. 3, 155-6(Mar 1972). (In German).

For experimental determination of heat transfer in fuel elements of sodium-cooled reactors, the fuel rods are simulated by electrically heated rods. Measurement of the cladding temperature is performed with thin, coated thermoelements that are welded or soldered to the cladding. An improved method is outlined which yields significantly higher accuracy. At the measuring point, the MgO insulation of a coated thermoelement with 0.5 mm diameter is replaced by boron nitride. Response time of the element is 17 msec. Calibration of the elements and of the heated rods is discussed. (H.B.G.)

27585 SYSTEMATIC PROCEDURE FOR TIGHTENING THE BOLTS OF REACTOR PRESSURE VESSEL FLANGES. van Campen, D. H. Polytech. Tijdschr., Procestech.; 26: 190-5(3 Mar 1971). (In Dutch).

A systematic semi-empirical procedure is proposed to tighten a bolted flange connection where the bolts are divided into groups and these groups are prestressed successively by hydraulic jacks. The only assumption made in this procedure, supported by experimental evidence, is the proportionality between the bolt force after prestressing and the jack pressure in the pressure area under consideration. Starting with an arbitrary tightening experiment (for example the pressure test) it is possible to establish an accurate tightening procedure that results in nearly the same normal force in all the bolts. The experiments from which the aforementioned results were gleaned are described and discussed in detail. (auth) (Netherlands)

27586 NUCLEAR FUEL ASSEMBLY. (to Westinghouse Electric Corp.). British Patent 1,254,040. 17 Nov 1971. Priority date 26 Nov 1968, United States.

REACTOR FUEL ELEMENTS— support structure for bundle arranged rods (D.C.C.)

Reactor Physics and Core Engineering

Physics

Refer also to abstracts 25615, 25637, 25704, and 27376.

27587 (AEEW-R-724) SPATIAL TRANSFER FUNCTIONS AND THE SYNTHESIS OF MULTIVARIABLE FEEDBACK SYSTEMS FOR THE CONTROL OF THE RADIAL-AZIMUTHAL MODES OF A CYLINDRICAL NUCLEAR POWER REACTOR. Owens, D. H. (Atomic Energy Establishment, Winfrith (England)). Jan 1971. 59p. Dep. NTIS (U. S. Sales Only).

The way that the matrix, H(s), of plant transfer functions representing the input-output relationships of a symmetric azimuthal control and observation configuration can be used in the synthesis of a feedback system for the control of the azimuthal spatial power modes of a cylindrical nuclear reactor is described. Using some simple algebraic consequences of group theory, it is shown that the control of this symmetric multi-dimensional system may be accurately reduced to a series of single input, single-output control problems. The problems are readily solved by the familiar classical approaches such as the Nyquist diagram and root-locus plots. An important feature of the technique is its ability to incorporate a control scheme in which all power measurements made in the sectors of the core can be used as a basis for the control decision in any one sector. The use of the technique in the analysis of the control of radial-azimuthal power modes is also discussed. 9 references. (auth)

27588 (BNWL-SA-4164) SPECTRUM AVERAGED CROSS SECTIONS DEDUCED FROM BURNUP DATA AND THEIR APPLICATION TO METHODS VERIFICATION. Schmid, L. C.; Christensen, D. E.; Duane, B. H.; Liikala, R. C.; Matsen, R. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1971]. Contract AT(45-1)-1830. 71p. Dep. NTIS.

The determination of ratios of spectrum averaged cross sections from isotopic concentrations is described along with their application to verification of analytical reactor design tools. The determination is made using specially developed least squares computer programs which fit the mathematical transmutation relationships to isotopic concentrations measured in irradiation experiments. These data are utilized as a basis for evaluating the accuracy of calculational methods used to predict burnup behavior of nuclear fuels. Data obtained from irradiation experiments using plutonium–aluminum alloy fuel are given to illustrate the techniques and demonstrate how these data are used to verify calculational methods. (60 references) (auth)

27589 (CNLM-4330(Suppl.1)) AN EMPIRICALLY ESTABLISHED METHOD OF ANALYTICALLY DETERMINING CRITICALITY OF SMALL, FAST REACTORS WITH SIGNIFICANT NIOBIUM AND BERYLLIUM CONTENT. Johnson, C. W., Jr. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 3 Sep 1963. Contract AT(30-1)-2789. 4p. Dep. NTIS.

Declassified 4 Nov 1971.

27590 (DP-1283) HAMBUR SYSTEM. Finch, D. R.; Christman, R. P. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Feb 1972. Contract AT(07-2)-1. 127p. Dep. NTIS.

The HAMBUR System is a set of linked computer programs for the calculation of (1) infinite lattice parameters by multigroup transport theory, (2) composite reactor parameters by few-group diffusion theory using finite difference or source-sink methods, and (3) infinite lattice or reactor supercell depletion-production history by straight time march method. Procedures are given for using the system of linked reactor physics codes, and a detailed description of the methods used in generating the depletion-production history is given. 15 references. (auth)

27591 (EIR-204) MEASUREMENT OF THE EFFECT OF FAST FISSION IN A D_2O-MODERATED URANIUM REACTOR BY MEANS OF A SEMICONDUCTOR DETECTOR MOUNTED IN A FUEL ELEMENT. Ruegger, Bertrand (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jul 1969. 104p. (In French). Dep. NTIS (U. S. Sales Only).

A method was developed which permits a direct measurement of fissions in the fuel element by use of a semiconductor detector with large surface placed in the element itself. Calibration is thus avoided. The detector should be as thin as possible in order to limit the perturbations of the neutron flux. By using the two faces

of the crystal, it was possible to place two detectors in a 0.17-mm slit almost perpendicular to the axis in a natural uranium rod 20 mm in diameter. These two detectors make it possible to count simultaneously the fissions taking place in the two families of uranium with different enrichments. The measurements were made in the MINOR critical assembly with a flux of the order of 10^5 n/cm^2/sec. The difficulties caused by the very low counting rate led to the development of a very efficient solution of the electromagnetic parasites captured by the measurement chain. The results obtained by this method are in perfect agreement with the measurements made by Wolberg et al. and coincide with the theoretical value calculated by Rognon. 53 references. (tr-auth)

27592 (JAERI-M-4587) GENERALIZED PERTURBATION CODE GENPER-2 FOR CALCULATION OF REACTIVITY AND ITS RATIO. Seki, Yasushi; Yoshida, Hiroyuki; Iijima, Susumu (Japan Atomic Energy Research Inst., Tokyo). Sep 1971. 32p. (In Japanese). NTIS (U. S. Sales Only).

The generalized perturbation method is used for calculation of the reaction-rate ratio, reactivity, and reactivity ratio in a nuclear reactor. Advantages of this method over the ordinary perturbation method used in calculation of reactivities are a large scope of the application, high accuracy with less computation time, and convenience in reactor-physics analyses. A computation code GENPER-2 was developed to calculate the ratio of bilinear functionals of neutron flux and its adjoint function. The accuracy of the generalized perturbation method is examined in comparison with the direct calculation and ordinary perturbation methods. Problems in formulation and application of the method are also solved. (auth)

27593 (JAERI-M-4588) APPLICABILITY OF ONE-GROUP DIFFUSION THEORY FOR ANALYSIS OF BURN-UP CHARACTERISTICS OF THE FAST REACTOR. Yoshida, Hiroyuki; Tasaka, Kanji (Japan Atomic Energy Research Inst., Tokyo). Sep 1971. 47p. (In Japanese). NTIS (U. S. Sales Only).

Burnup characteristics of a fast reactor, i.e. variations of the effective multiplication factor, power distribution and atomic number densities, were analyzed using one-group diffusion theory. The applicability of one-group diffusion theory for burnup analysis of the fast reactor was studied by comparing with the multigroup diffusion theory. The following were concluded: (1) One-group reactor constants, used in the one-group diffusion equation, vary considerably with the burnup. (2) The variations of power distribution and atomic number densities can be estimated with high accuracy, with one-group reactor constants in virgin state. (3) The variation of effective multiplication factor cannot be estimated by one-group reactor constants based on the ordinary definition, but can be estimated accurately with one-group reactor constants based on the perturbation theory. It was found that various burnup characteristics of the fast reactor can be known by the burnup analysis based on one-group diffusion theory with one-group reactor constants in virgin state. In addition, the approximate method was developed of representing the burnup-dependent one-group reactor constants; and the calculational results were examined. (auth)

27594 (TRG-Report-2189) SPECTRA OF ENERGY RELEASED BY THERMAL NEUTRON CAPTURE. Sidebotham, E. W. (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). 1972. 8p. Dep. NTIS (U. S. Sales Only). UK 0.50 pound.

Neutron capture gamma spectra are required to determine the true heat generation in reactors and its distribution over the core materials. It was observed that experimentally determined spectra although accurately determined in fine detail rarely equate to the binding energy because of continuum of energies in the middle range. A method was devised to allocate the gamma energy spectra, corrected to the binding energy, to certain kernel energies which are of importance in determining the heating distribution in reactor core materials. Tables of thermal neutron capture gamma and radioactive decay energy spectra cover elements, compounds, alloys and fission product groups more frequently present in reactor cores. (auth)

27595 (UJV-2699-R) PROGRAM FOR THE CALCULATION OF HETEROGENEOUS CONSTANTS: PETRUS. Lelek, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1971. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

A brief description is given of an algorithm for calculating a heterogeneous constant γ (thermal constant) under conditions of constant moderation density. The calculations require agreement of the coefficient of thermal use with the corresponding transport value. A non-zero flux of thermal neutrons in the cell is assumed. A complete description of the program is given, including examples of input and printed output. (tr-auth)

27596 (UJV-2700-R) ANDREAS: PROGRAM FOR CALCULATING BOUNDARY CONDITIONS OF A CELL IN A REACTOR. Lelek, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1971. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

An algorithm is offered for the calculation of a flux of thermal neutrons in a cell of a heterogeneous reactor assuming a constant moderation density. The nearest nine rods are used in establishing the flux; at the boundary of these rods is placed a new boundary condition. A complete description of the program is presented, with examples of input and printed output. (tr-auth)

27597 (UJV-2701-R) PROGRAM FOR THE CALCULATION OF TWO-GROUP HETEROGENEOUS CONSTANTS: THOMAS. Lelek, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1971. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

An algorithm is described for the calculation of two-group heterogeneous constants. A rod was characterized by four parameters: a quantity of secondary neutrons η, the absorption of thermal neutrons γ, the absorption of fast neutrons ω, and the transition of fast neutrons to slow σ. These parameters are so chosen that the basic integral values which characterize a cell coincide with the corresponding transports. A non-zero flux of both fast and slow neutrons is assumed to enter a cell. A complete description of the program, with input and printed output, is given. (tr-auth)

27598 DETERMINATION OF STABILITY DOMAIN OF REACTOR WITH SINGLE TEMPERATURE AND PROMPT POWER COEFFICIENT. Numano, Masahiro; Nishihara, Hideaki; Abe, Hiroshi (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 3, 157-64(Mar 1972).

Determination of the stability domain was studied for nonlinear reactor problems. An approximate stability boundary was determined analytically in the state space by observing the nature of trajectories and with the help of isoclines. This approximation can be improved to any higher degree. The method was applied successfully to the problem of one-point, effective neutron-lifetime reactor-model with linear temperature and power coefficients and cooled by Newton's law, and to a modified system with nonlinear feedback characteristics. The former example is a well-investigated test case, and the present method resulted in a stability domain larger than those determined by most other methods except numerical determination using computer. (21 references) (auth)

27599 INFINITE MEDIUM GREEN'S FUNCTION WITH ENERGY DEPENDENCE. Papmehl, N.; Zech, H.-J. (Gutehoffnungshuette Sterkrade AG, Oberhousen, Ger.). Atomkernenergie; 18: No. 4, 281-5(Dec 1971). (In German).

Starting from the B_L-formalism the energy dependent Green's function is calculated in plane geometry. An equation formally equivalent to a slowing-down-equation is derived and solved analytically assuming constant cross sections. For the first three scattering intervals the exact solutions are given. They show the familiar Placzek discontinuities clearly visible near the source but decreasing rapidly with greater distance from the source plane. For lethargy values beyond 3 q an asymptotic solution is given. Considering a pure, isotropically scattering carbon medium as reference material, it is shown that the familiar Taylor expansion gives better results in the interesting asymptotic region than the asymptotic approach referred to above. (5 references) (auth)

27600 TREATMENT OF SLOPING PLANE BOUNDARY INTERFACES IN THE EIGENFUNCTION EXPANSION METHOD. Elmeshad, Y. (Univ. of Alexandria, Egypt); Gohar, Y. Atomkernenergie; 18: No. 4, 274-80(Dec 1971).

An analytical method is proposed for solving criticality problems in a multigroup diffusion formulism for multiregion geometries with sloping plane boundary interfaces between the regions. The method is based on eigenfunction expansion, and is applicable to geometries with rectangular parallelepiped outer boundary. The method leads to the evaluation of some surface integrals along the boundary interfaces and some volume integrals for the case of three dimensional problems. In the case of two dimensional problems, these integrals reduce to line and surface integrals. For simple reactor geometries which have boundary interfaces in the form of combinations of: planes parallel to one of the axes (e.g. the z axis) and sloping with respect to the other axes; and planes perpendicular to the same axis. The integrals can be evaluated analytically; and closed analytical forms for the integrals involved are given. (9 references) (auth)

27601 USE OF EIGENFUNCTION EXPANSION METHOD FOR SOLVING MULTIGROUP CRITICALITY PROBLEM. Elmes-

had, Y. (Univ. of Alexandria, Egypt); Elmofty, O.; Gohar, Y. Atomkernenergie; 18: No. 4, 267-73(Dec 1971).

An analytical method for using the eigenfunction expansion technique for multigroup multiregion three dimensional criticality problems is proposed and developed. Symmetrical and asymmetrical problems with outer parallelepiped geometries can be treated. An interesting feature of the proposed method is that although the source term for any particular group may come from any of other groups, the order of the criticality determinant is independent on the number of groups. An eight energy-group two region one dimensional problem was treated and the results show very good agreement with the published data for an equivalent two group problem. A two dimensional fully reflected reactor with a water gap placed asymmetrically inside the reactor is also treated and the results are given. (9 references) (auth)

27602 SPECIFIC NONLINEAR AND TRANSPORT PROBLEMS OF REACTOR THEORY SOLVED BY THE EVOLUTION OPERATOR METHOD. Abedin-Zadeh, R.; Pucker, N. (Univ., Graz). Atomkernenergie; 18: No. 4, 255-60(Dec 1971).

The evolution operator method is applied to three different problems of reactor theory. Two of them (reactor with constant power removal and temperature dependent kinetic behavior; steady state reactor with Xenon poisoning) are non-linear. The third one treats the perturbation of a critical reactor in transport theory with the means of the evolution operator. It is demonstrated that this method is a very advantageous approximation procedure, especially for non-linear problems. (10 references) (auth)

27603 BOUNDEDNESS, CONTINUITY, POSITIVITY, AND DOMINANCE OF THE SOLUTION OF THE NEUTRON BOLTZMANN EQUATION. Premuda, Francesco (CNEN, Bologna). Meccanica; 6: No. 4, 204-11(Dec 1971).

The behavior of the solution of the integral form of the neutron transport Boltzmann equation is investigated for slab and sphere geometry. The study of the properties of the integral transport operator K leads to interesting results concerning the following subjects: boundedness, continuity and positivity of the total flux; existence of a dominant critical eigenfunction; spectral properties of K; dependence of the critical eigenvalue on the dimensions of slab and sphere; uniform convergence of the Neumann series in subcritical conditions; approach to the criticality; summability of the solutions and neutron conservation. (26 references) (auth)

27604 YADERNYE REAKTORY I PRINTSIP MAKSIMUMA PONTRYAGINA. (Nuclear Reactors and Pontryagin's Maximum Principle). Rudik, A. P. Moscow; Atomizdat (1971). 208p.

The problems of optimizing the physical characteristics of nuclear reactors are considered, with emphasis on the mathematical approach propounded by L. S. Pontryagin. Elementary examples taken from the nuclear reactor field are treated, and three-dimensional optimization problems, and problems concerning optimum transitional processes are solved. Reactor control with distributed parameters, shielding problems in a reactor, optimum isotope irradiation, xenon distribution control, and dynamic programming are topics considered of importance. (19 references) (tr-auth)

27605 MULTIGROUP CRITICALITY CONDITION OF A BARE HETEROGENEOUS REACTOR. Rocek, Jindrich; Miasnikov, Alexandr (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 18: No. 3, 76-80(Mar 1972).

The multigroup criticality condition of a bare reactor is derived by means of the heterogeneous method. The result differs from the corresponding critical condition of a homogeneous reactor by including the influence of fine structure of the slowing down density. (auth)

27606 REACTOR POWER DISTRIBUTION FROM ANALYSIS OF IN-CORE DETECTOR READINGS. Levine, M. M.; Diamond, D J. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng.; 47: No. 4, 415-20(Apr 1972).

A method is developed for obtaining information about reactor power shapes from readings of in-core detectors. The readings are used to determine the coefficients for an expansion of the space-dependent power in terms of a set of basis functions. A least squares approach ensures that all the detector readings contribute to the result. Test cases for one-, two-, and three-dimensional distributions show that accurate results can be obtained with a rather simple choice of basis functions. (auth)

27607 INVESTIGATION OF SPACE-DEPENDENT REACTOR TRANSFER FUNCTIONS WITH TEMPERATURE FEEDBACK. Bridges, D. N.; Clement, J. D. (Georgia Inst. of Tech., Atlanta). Nucl. Sci. Eng.; 47: No. 4, 421-34(Apr 1972).

The investigation involved a theoretical and experimental study of space-dependent reactor transfer functions with temperature feedback. The reactor transfer function under investigation was the neutron flux response to an input perturbation or source. An existing theoretical model, known as the complex source method, was extended to include temperature feedback effects and the resultant equations were programmed for a model of the Georgia Tech Research Reactor (GTRR). Spatial transfer function measurements were made in the GTRR using an in-core pile oscillator employing a pseudo-random binary sequence. Several detector locations were investigated for both zero-power and at-power (900 kW) conditions over a frequency range from 4×10^{-4} to 8.5 Hz. Data were taken and stored on magnetic tape using two PDP-8 computers and a magnetic tape unit. The theoretical calculations and the experimental results agreed quite closely. Temperature feedback effects for the GTRR were observed to occur at frequencies of 2×10^{-2} Hz and lower, and to become quite pronounced below 1×10^{-3} Hz. Spatial effects were observed to be significant only for frequencies above 1 Hz. (auth)

Core Thermal Hydraulics

Refer also to abstract 27395.

GENERAL

Law

Refer also to abstracts 25652, 25799, and 26167.

27608 (ANL–7914) LOW-ORDER GAUSS–CHRISTOFFEL QUADRATURE. Abu-Shumays, I. K. (Argonne National Lab., Ill.). Feb 1972. Contract W-31-109-eng-38. 25p. Dep. NTIS.

This report describes a FORTRAN IV program capable of generating, simply and cheaply, problem-oriented low-order (n = 1, ..., 16) Gaussian quadrature formulas. The program is applicable whenever the weight function is sufficiently smooth and has known moments. The approach is algebraic and utilizes available matrix inversion subroutines. Two examples are given: these include an application for the numerical integration of functions with logarithmic singularities. (2 tables) (auth)

27609 (ARH–378) TRUE MANPOWER REQUIREMENTS TO PERFORM WORK UNDER RADIATION CONDITIONS. Morgenthaler, A. C. (Atlantic Richfield Hanford Co., Richland, Wash.). 1 Feb 1968. Contract AT(45-1)-2130. 7p. Dep. NTIS.

Methods used for the estimation of manpower requirements for work performed in radiation zones are discussed. Formulae are presented for estimation of work time requirements that take into account the total time required in the radiation zone, the dose rate to personnel (in mrad/hr) during this time interval, and the allowable daily personnel exposure limit. (C.H.)

27610 (HPA–2) GUIDANCE ON THE ACTION TO BE TAKEN IN THE EVENT OF INTAKE OF RADIOACTIVE MATERIAL INTO THE BODY. (Hospital Physicists' Association, London (England). Radiation Protection Committee). Jan 1970. 8p. Dep. NTIS (U. S. Sales Only).

The suggested action to be taken, when the appropriate levels of activity in the body are exceeded, is summarized. The bases for these levels are given. (UK)

27611 (LA–4867) CMB-5 HEALTH AND SAFETY MANUAL. Miner, W. N.; Elliott, R. O.; Douglass, D. L.; Schonfeld, F. W. (Los Alamos Scientific Lab., N. Mex.). Feb 1972. Contract W-7405-eng-36. 22p. Dep. NTIS.

Much of the work in Los Alamos Scientific Laboratory Group CMB-5 relates to studies of the physical metallurgy of plutonium and its alloys and compounds. Facilities and equipment were designed to provide a practicable amount of personnel protection against the hazards associated with that element. The equipment is enclosed in glove boxes or other protective enclosures and the procedures are closely controlled. A set of safety rules and related information concerning nonradioactive materials included in the second edition of the Chemistry and Metallurgy Safety Manual; information from the CMF-5 Health and Safety Booklet (1959); the CMF-5 Safety Regulations and Operating Procedures (1961, revised through 1969); and the LASL Health and Safety Manual were used in compiling this CMB-5 Health and Safety Manual. (C.H.)

27612 PROBLEM OF LIABILITY IN THE FUTURE GERMAN ATOMIC ENERGY LAW. Hoeft, E. Versicherungswirtschaft; No. 4, 189-90(1970). (In German).

The Federal Republic of Germany signed the Atomic Liability Agreement of Paris but has not yet ratified. In case of ratification the insurers insist on keeping the economical canalization of the liability now valid and not to transfer the so-called legal canalization of liability as it is primarily provided in the agreement into the German law. (INIS)

Miscellaneous

27613 (AEC-WO–604) NON MILITARY USES OF NUCLEAR EXPLOSIVES BOOTHIA PENINSULA PRELIMINARY BLASTING ANALYSIS. Chapman, R. L. (California Univ., Berkeley. Lawrence Radiation Lab.). 11 Mar 1958. 16p. Dep. NTIS.

Declassified 28 Oct 1971.

27614 (AEC-WO–606-L) ISTHMUS OF TEHUANTEPEC INVESTIGATION FOR OPERATION PLOWSHARE. Bacigalupi, Clifford M.; Miles, Robert A.; Warren, Fred J. (California Univ., Livermore. Lawrence Radiation Lab.). 25 Mar 1958. 40p. Dep. NTIS.

Declassified 28 Oct 1971.

27615 (AECL–4071) FRONTIER EVENTS IN ELECTRICAL, ELECTRONIC, AND RADIO ENGINEERING FROM PICOWATTS TO TERAWATTS IN THE LAST 40 AND THE NEXT 60 YEARS. Lewis, W. Bennett (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Nov 1971. 20p. Dep. NTIS (U. S. Sales Only). AECL $0.50.

27616 (ANCR–1052) NRTS 360/75 COMPUTER SYSTEM JOB ACCOUNTING AND SCHEDULING ROUTINES. Tyler, F. H.; Mueller, R. L.; Moore, G. J. (Aerojet Nuclear Co., Idaho Falls, Idaho). Jan 1972. Contract AT(10-1)-1375. 72p. Dep. NTIS.

27617 (ANL/ES–8) ISOPLETH-AREA TABLES. Conley, L. A.; Croke, E. J.; Kennedy, A. S.; King, R. F.; Norco, J. E.; Roberts, J. J.; Rossin, A. D.; Wolsko, T. D. (Argonne National Lab., Ill. Chicago Dept. of Environmental Control, Ill.). Oct 1971. Contract W-31-109-eng-38. 306p. Dep. NTIS.

27618 (ANL/ES–9) STUDIES OF THE ARGONNE INTEGRATED-PUFF MODEL. Rote, D. M.; Gudenas, J. W.; Conley, L. A. (Argonne National Lab., Ill.). Oct 1971. Contract W-31-109-eng-38. 106p. Dep. NTIS.

The development of a simple steady-state dispersion model based on the Gaussian plume expression to be used for comparison with the Argonne Integrated-puff Model was completed. Documentation of the plume model along with computer program listings and an example computation of SO_2 concentrations are presented. In order to extend the applicability of the plume model to very low wind speeds, a special "calm algorithm" was developed. The plume model was validated by comparing calculations both with observed concentrations and calculations using the puff model. When applied to a complete urban source emission inventory both the puff and plume models were found to be in relatively close agreement under a wide variety of circumstances. A good understanding of the relationship between the integrated puff kernel and the Gaussian plume expressions was obtained by performing detailed analytical and numerical analyses. Finally, a sensitivity analysis was carried out with the plume model. Sensitivity to the use of Midway measured winds instead of the more well defined TAM station winds was studied along with the effect of introducing systematic errors of ±15° in the TAM measured wind directions. In addition, the effect of introducing systematic errors into the lid height was also analyzed. A determination of the magnitude of expected errors in the lid height was obtained by making a comparison study of several techniques for estimating the lid height from radiosonde measurements. (auth)

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